

SCIENCE

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FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MARCH 19, 1909

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THE FIRST PAN-AMERICAN SCIENTIFIC CONGRESS, HELD IN SANTIAGO, CHILE, DECEMBER 25, 1908—JANUARY 6, 1909

THE first Latin-American Scientific Congress, which was convened in Buenos Aires in 1898, was projected by the Scientific Society of that city, and successfully carried out. It was attended by representatives of twelve Latin-American republics, and yielded results of such importance that a second congress was convened at Montevideo in 1901; and this was followed by a third at Rio Janeiro in 1905. Arrangements were made for a fourth meeting at Santiago, Chile, in 1908, and the Chilean organization committee,¹ feeling that the activities of the congress, which had been limited to the discussion of Latin-American problems and interests chiefly, should be extended to a fully Pan-American scope, decided that the Santiago meeting should be known as "The First Pan-American Scientific Congress."

The organization committee, through the medium of the Chilean government, extended to the government of the United States an invitation to participate. Secretary Root brought the matter to the attention of President Roosevelt,² and the

¹ The organization committee was constituted as follows: *Honorary President*, Marcial Martinez; *President*, Valentin Letelier; *Vice-president*, Manuel E. Ballesteros; *General Secretary*, Eduardo Poirier; *Assistant Secretary*, Augusto Vicuna S.; *Treasurer*, Octavio Maira; Alejandro Alvarez, Jose Ramon Gutierrez, Salvador Izquierdo S., Alejandro del Rio, Miguel Varas, Luis Espejo Varas, Anselmo Hevia Riquelme, Vicente Izquierdo, Domingo V. Santa Maria.

² *The President:* The government of Chile has invited the government of the United States to

President transmitted the invitation to Congress, accompanied by a commendation in and to be represented by delegates at the Pan-American Scientific Congress, which is to assemble under its auspices at the capital city of Santiago during the ten days beginning December 25, 1908. The work of the congress will comprehend nine sections, devoted, respectively, to pure and applied mathematics, physical sciences, natural sciences, engineering, medicine and hygiene, anthropology, jurisprudence and sociology, pedagogics, and agriculture and animal industry.

Latin-American scientific congresses were held in 1898 at Buenos Aires, in 1901 at Montevideo and in 1905 at Rio de Janeiro. Growing out of these previous conferences the congress of 1908 will be for the first time Pan-American. It will study and discuss many great subjects in which all the American republics have in common special interests; and its aim is to bring together the best scientific thought of this hemisphere for the scrutiny of many distinctively American problems and for an interchange of experience and of views which should be of great value to all the nations concerned.

It is therefore eminently appropriate that the United States should be adequately represented at this important First Pan-American Scientific Congress and should embrace this opportunity for cooperation in scientific research with the representatives of the other American republics. It is worthy of consideration that, in addition to the purely scientific interests to be subserved by such a congress and in addition to the advantages arising from an interchange of thought and the intercourse of the scientific men of the American countries and the good understanding and friendly relations which will be promoted, there are many specific relations arising from the very close intercourse between the United States and many Latin-American countries, incident to our expanding trade, our extending investments, and the construction of the Panama Canal, which make a common understanding and free exchange of opinion upon scientific subjects of great practical importance.

To make our representation possible I have the honor to recommend that the Congress be asked to appropriate the sum of \$35,000, or so much thereof as may be necessary, to enable the United States to send a number of delegates corresponding to the number of sections into which the congress is to be divided, together with a secretary

tory message.³ In due course the invitation was officially accepted, and a liberal sum appropriated for the purposes of the congress. The committee of organization also extended invitations, through the Department of State at Washington, to a number of universities and other institutions and societies. As a result a large delegation was accredited to the congress. The membership of the delegation and the institutions represented are as follows:

Government Delegates

L. S. Rowe, University of Pennsylvania.
Paul S. Reinsch, University of Wisconsin.
Hiram Bingham, Yale University.
A. C. Coolidge, Harvard University.

and disbursing officer, and to pay other necessary expenses.

Inasmuch as it is desired that all communications or scientific works to be presented to the congress be received before September 30, it is much to be hoped that provision for the participation of this government may be made at an early date and that the appropriation be made immediately available.

Respectfully submitted,

ELIHU ROOT

Department of State,

Washington, December 19, 1907.

To the Senate and House of Representatives:

I transmit herewith for the consideration of the respective Houses of the Congress a report of the Secretary of State representing the appropriateness of early action in order that in response to the invitation of the government of Chile the government of the United States may be enabled fittingly to be represented at the First Pan-American Scientific Congress, to be held at Santiago, Chile, the first ten days of December, 1908.

The recommendations of this report have my hearty approval, and I hope that the Congress will see fit to make timely provision to enable the government to respond appropriately to the invitation of the government of Chile in the sending of delegates to a congress which can not fail to be of great interest and importance to the governments and peoples of all the American republics.

THEODORE ROOSEVELT

The White House,
December 21, 1907

William C. Gorgas, United States Army.
 W. H. Holmes, Smithsonian Institution.
 Bernard Moses, University of California.
 George M. Rommel, Bureau of Animal Industry.
 W. R. Shepherd, Columbia University.
 W. B. Smith, Tulane University.

University Delegates

Bernard Moses, University of California.
 Albert A. Michelson, University of Chicago.
 J. Lawrence Laughlin, University of Chicago.
 W. R. Shepherd, Columbia University.
 Thomas Barbour, Harvard University.
 A. C. Coolidge, Harvard University.
 J. B. Woodworth, Harvard University.
 Adolph Hempel, University of Illinois.
 W. H. Holmes, George Washington University.
 Orville A. Derby, Cornell University.
 H. D. Curtis, University of Michigan.
 W. F. Rice, Northwestern University.
 L. S. Rowe, University of Pennsylvania.
 Webster L. Browning, Princeton University.
 William B. Smith, Tulane University.
 Paul S. Reinsch, University of Wisconsin.
 Hiram Bingham, Yale University.

Scientific Societies

L. S. Rowe, American Academy of Political
 and Social Science.
 L. J. Doran, National Educational Association.

In June, 1908, meetings of the government delegates were held at the State Department, Washington, under the tutelage of Secretary Root, who conveyed to them such instructions as were deemed necessary. Arrangements were made for the preparation and translation of papers dealing with appropriate subjects for presentation at the congress, and for the disposal of the sum allotted by the Department for the purposes of the congress. The organization of the delegation was completed by the selection of Dr. L. S. Rowe as chairman and Professor Paul S. Reinsch as vice-chairman.

Under the guidance of Dr. Rowe a number of the delegates assembled in Buenos Ayres early in December, where they were the recipients of the hospitality of the president of the republic and the members of his cabinet, and of the ministers of the

United States and Chile. Visits were made to numerous institutions of learning, hospitals, municipal buildings, parks, etc., and the visit to the University of La Plata was signalized by an exceptionally cordial interchange of courtesies. On December 10 the party crossed the Andes and established headquarters in the Hotel Oddo in Santiago. Here, before and during the sittings of the congress, the delegation held frequent meetings to plan and discuss their work in the congress. Meantime other delegations, representing seven North American and Central American and nine South American republics, were on hand; and the meeting for the selection of officers for the congress was held at the University of Chile on December 24.⁴

At 10 P.M. on Christmas Day the opening session was held in the spacious Municipal Theater, and proved a most impressive ceremony. The president of the republic, Señor Pedro Montt, was present, and addresses were made by various officials of the congress and by chairmen of the various national delegations. The address of Dr. Rowe, chairman of the American delegation, delivered in Spanish, was enthusiastically received.⁵

* The result was as follows: *President*, Enrique R. Lisboa, Envoy Extraordinary and Minister Plenipotentiary of Brazil; *Vice-presidents*, Lorenzo Anadon, Envoy Extraordinary and Minister Plenipotentiary of Argentina; Fredrico Susviela Guarch, Delegate of Uruguay, and Matias Manzanilla, Delegate of Peru; *Secretaries*, Emilio Fernandez, Delegate of Bolivia; Melchor Lasso de la Vega, Delegate of Panama, and Enrique Martinez Sobral, Delegate of Mexico.

⁵ ADDRESS OF DR. L. S. ROWE AT THE OPENING SESSION

Your Excellency, Ladies and Gentlemen:

This congress possesses an historical significance which it is difficult for us to appreciate at the present time. It marks an epoch in the intellectual development of the American continent.

Complete isolation from one another has characterized the situation of the countries of this

The committee of organization was prompt in the preparation of the program continent. This isolation has been one of the greatest obstacles to progress. The failure to develop a spirit of intellectual cooperation has resulted in a great loss of energy and has been one of the most important obstacles to the solution of many problems which would long ago have been solved had we been able to unite our energies and profit by each other's experience. The true scientific spirit has a far deeper significance than the mere desire to conduct investigations. It can not reach its highest expression if there exist petty rivalries or jealousies. For this reason the development of the scientific spirit contributes so much to the growth of a true international fraternal spirit. A vigorous spirit of cooperation, developed amongst the scientists of the American continent, will enable us to destroy the last traces of the epoch in which the words "stranger" and "enemy" were synonymous.

The industrial development of the last century offers lessons of much importance to the scientific world. A study of the economic growth of modern countries clearly shows that the principle of competition is gradually giving way to the principle of cooperation.

The formation of trusts as well as the growth of trades' unions constitutes the concrete expression of these new tendencies. The eighteenth century and a considerable portion of the nineteenth were dominated by a spirit of individualism. During more than four generations, it was taken for granted that human progress is dependent on the struggle for existence and the conflict between individual and individual. During the nineteenth century the application of biological principles to human society strengthened this idea. It is the mission of the twentieth century to demonstrate that we must regard the principle of cooperation rather than that of competition as the fundamental principle of social progress.

In this congress it is our high privilege to inaugurate a new epoch giving concrete form to the idea of intellectual cooperation. In the International Bureau of American Republics we have a central organization admirably adapted to contribute toward the realization of this idea. We need such a center in order to place investigators in different portions of the American continent in contact with one another, and in order that the results of such investigations may be made the common property of all the nations of America.

of meetings, and the press of the city was most generous and helpful in its treatment of the congress. The sectional meetings, which continued during eight days, were held separately under the following heads:

1. Mathematics, Pure and Applied.
2. Physical and Chemical Sciences.
3. Natural Sciences—Biology, Paleontology, Geology, Anthropology, etc.
4. Engineering.
5. Medicine and Hygiene.
6. Jurisprudence.
7. Social Sciences.
8. Pedagogic Sciences.
9. Agriculture and Zootechny.

The program was followed, with necessary modifications from day to day. The majority of the papers were read in full or in extended abstracts, and discussion was free and often spirited. Naturally, popular interest centered largely about the sections dealing with practical problems, as education, sanitation, social science and engineering; but the more abstract sciences were not neglected. Owing to the great range of the work of the congress and the multiplicity of papers presented in the various sections, no attempt can be made in this place to present the work and results in detail. The list of papers presented by members of the American delegation and forwarded by the other

In the name of the delegation of the United States of America, I desire to express our sincere thanks for this opportunity to take part in the deliberations of this congress. No better opportunity could have been offered to become acquainted with our colleagues and fellow investigators. The ties here formed possess a significance far deeper than the personal satisfaction they imply. This visit can not help but enlarge our mental horizon, broaden our scientific activity, and strengthen the influence of our university instruction. We congratulate ourselves on the privilege of being present, and desire also to express our appreciation of the great service performed by this republic in giving such vigorous impulse to the spirit of scientific solidarity.

contributors for the United States is as follows:⁶

Astronomical Problems of the Southern Hemisphere: H. D. CURTIS.
The Electronic Theory of Matter: W. B. SMITH.
Recent Progress in Spectroscopy: A. A. MICHELSON.
Statistics of the Use of Nitrate of Soda in the United States: CHARLES E. MUNROE.
The Economy of Fuels: WILLIAM KENT.
Recent Studies in Experimental Evolution: THOMAS BARBOUR.
Notes on the Origin of the North American Prairies: C. H. HALL.
Origin of the Minnesota Iron Ores: C. H. HALL.
The Peopling of America: W. H. HOLMES.
The Newer Geological Views Regarding Subterranean Waters: JAMES F. KEMP.
The Mineral Wealth of America: R. W. RAYMOND and W. R. INGALLS.
The Shaler Memorial Expedition in Brazil and Chile: J. B. WOODWORTH.
The Application of Electricity to Railways: FRANK SPRAGUE.
Sanitation in the Tropics with Relation to Malaria and Yellow Fever: W. C. GORGAS.
Frequency and Prevention of Yellow Fever: C. J. FINLAY.
Notes on the Sanitation of Yellow Fever and Malaria from Isthmian Experience: H. A. CARTER.
Plague; Methods of Control: J. C. PERRY.
America in the Pacific: A. C. COOLIDGE.
America and International Law: PAUL S. REINSCH.
Public Opinion in the American Democracies: L. S. ROWE.
Why the English Colonies on Achieving their Independence Constituted a Single State, whereas the Latin-American Colonies could not Form a Federation among Themselves, nor even a Confederation: HIRAM BINGHAM.
Geological Work in Brazil: ORVILLE A. DERBY.
Foundations of the Spanish and English Colonial Civilization in America: BERNARD MOSES.
American Banks: J. LAWRENCE LAUGHLIN.
Uniformity and Cooperation in the Census Methods of the Republics of the American Continent: S. N. D. NORTH.
The Influence of Urban Environment on the Life and Thought of the People: L. S. ROWE.

⁶This list is in part a translation from the Spanish, and may be somewhat imperfect.

The Treatment of Indian Tribes of the United States: FRANCIS E. LEUPP.
Race Degeneration: W. B. SMITH.
The Reclaiming of Arid Lands in the United States: F. H. NEWELL.
Instruction in Animal Husbandry at Agricultural Colleges of the United States: GEORGE M. ROMMEL.
National Sanitary Police in the United States: GEORGE M. ROMMEL.
The Tendencies of Female Education and its Bearing on the Social Mission of the Women of America: WM. F. RICE.
Laws of Heredity: THOMAS BARBOUR.
Adaptation of Instruction to the American Social Medium: W. R. SHEPHERD.
Nurses as Assistants in the Medical Inspection of Schools: DORA KEEN.
Recent Advances in the Study of Typhoid Fever: M. J. ROSENAU.
Pensioning Mothers who Depend on the Labor of their Sons, to Enable the latter to Pursue their Studies: DORA KEEN.
Plans and Gauges of Intercontinental Railways: WM. J. WILGUS.
Some Phases of the Early History of Mexico and Central America: ALCÉE FORTIER.
The Writing of History in the United States: W. M. SLOANE.
The Value of Gas Power: CHARLES E. LUCKE.
Uniformity of Commercial Law throughout the American Continent: ROSCOE POUND.
Pan-American Terminology: C. O. MAILLOUX.
Car Lighting in North America: R. M. DIXON.
Reinforced Concrete Construction for South America: WM. H. BURR.
The New Philippine Currency System: E. W. KEMMERER.
Water Supply of Cities and Towns: ALLEN HAZEN.
Use of Tertiary Coals in General Metallurgy and in the Manufacture of Coke: WM. HUTTON BLAUVELT.
The Supply of Potable Water: RUDOLPH HERING.
An Analysis of Five Hundred Cases of Epidemic Meningitis Treated with the Antimeningitis Serum: JAMES W. JOBLING and SIMON FLEXNER.
American Agriculture in Its Relation to Chilean Nitrate: WM. S. MYERS.
The Processes for the Concentration of Ore: ROBERT H. RICHARDS.
Future Supply of Iron Ore: HENRY M. HOWE.

The concluding session of the Congress was held at the university in the forenoon of January 5, and various matters of gen-

eral interest were disposed of. These included a discussion of methods of procedure, policy and scope of future congresses, relation of the congress to government and science, etc. A number of resolutions, passed by the sections or presented by the delegations, were offered and adopted.⁷

⁷ Resolution, extending to the governing board and director of the International Bureau of American Republics the thanks of the Pan-American Scientific Congress for the offer of cooperation:

WHEREAS: The Pan-American Scientific Congress has received with much satisfaction the cordial message of greetings from the Bureau of American Republics, and the kind offer of cooperation, be it

Resolved, That the formal thanks of the congress be transmitted to the governing board and director of the bureau, and that it be recommended to the members of the organization committee of the next Scientific Congress to avail themselves in every possible way of the valuable services which the bureau can render.

Resolution, recommending the establishment of a Section of American Bibliography in the International Bureau of the American Republics.

Recognizing the importance of establishing closer relations between investigators throughout the American continent and of disseminating the results of scientific investigations, the Pan-American Scientific Congress

Resolves, To recommend to the governing board of the International Bureau of the American Republics:

1. That a special section be established in the International Bureau of the American Republics to be known as the "Section of American Bibliography."

2. That the director of the bureau invite authors and investigators to send their publications to the bureau, on receipt of which notice thereof will be published in the Bulletin, which notice shall include a brief summary of the contents of such publication and the price thereof.

3. That the bureau secure for investigators any such publications at a price to be indicated in the Bulletin.

4. That the bureau endeavor so far as practicable to secure official publications for investigators.

5. That the bureau keep a record of the published progress of larger schemes of scientific investigations of Pan-American bearing.

By a practically unanimous vote it was decided to hold the next meeting in Washington in October, 1912. This action was cabled to the State Department, and Secretary Root responded in the following message:

Please express to the Pan-American Scientific Congress the satisfaction with which this government receives the announcement that Washington has been selected as the meeting-place of the congress in 1912.

A committee of five members⁸ was appointed to arrange with the Department of State at Washington for the appointment of a permanent organization committee for the prospective meeting.

A farewell session was held in the Municipal Theater on the afternoon of January 5, at which fitting addresses were made by officials and delegates;⁹ and at

⁸ L. S. Rowe, George H. Rommel, W. H. Holmes, John Barrett, director of the Bureau of American Republics, and Elmer E. Brown, commissioner of education.

* CLOSING ADDRESS OF DR. L. S. ROWE

Mr. President, Ladies and Gentlemen:

The honor conferred upon my country through the designation of Washington as the next meeting place of this great assembly is the more significant because of its spontaneous character. For this demonstration of confidence, good will and fraternal solidarity I want to thank you, not only in the name of the delegation of the United States of America, but also on behalf of that larger body of scientists and investigators who are imbued with the same spirit that has actuated this congress, and who now look forward to the privilege of welcoming to our shores the men upon whose efforts the progress of this continent depends. We can not hope to surpass the hospitality of this great republic, but we can assure you that the welcome will be no less sincere, and the determination to place every possible facility at your disposal, no less effective than has been the case here in Chile.

Viewed in its proper perspective, this congress has been one of the most extraordinary assemblages of modern times; more extraordinary in many respects than either the Hague or the Pan-American conferences. That a large group of men,

night a dinner was given in the hall of the university, at which there was a generous representatives of every section of a great continent, should be able to get together and, casting aside all petty prejudices, freely and frankly exchange the results of their careful investigations and ripe experience, is not only a tribute to the culture of this continent, but is also an indication of the extent to which our ideas have advanced beyond those which we inherited from our European mother countries.

The fact that we have met to place the results of the best scientific thought at the disposal of all the countries here represented, and through them at the service of the civilized world, contains a lesson of deep and lasting import which no other assembly of modern times has been able so clearly to impress upon the civilized world.

The historian of the intellectual development of the American continent, in reviewing the work of these assemblies, will probably give to the Santiago congress the honor of having clearly demonstrated that the republics of the American continent, because of their geographical position; because of the peculiar conditions under which they were settled; and because of the special racial problems which they present, are confronted by a series of problems distinctively American. The mere fact of the existence of these problems involves an obligation not only to ourselves, but to the civilized world to concentrate our efforts upon their solution. Through their solution we can make that contribution to the progress of mankind which the world has the right to expect of us.

We can best hope to do this by carrying to our respective countries the spirit that has hovered over this congress—that of service in its broadest and highest sense. This spirit of service must be made the key-note of our national and of our international relations. The republics of the American continent must demonstrate to the civilized world that the willingness and determination to be of service to our fellow-men is the cornerstone of a philosophy which the nations of this continent are determined to make the guiding principle of their conduct.

I can see a time, not far distant, when with each conquest of science the question will immediately arise in the mind of every American, "How can these results be made of service to the democracies of this continent?"—a time when in every field of endeavor the American republics may call upon one another for counsel in the solu-

expression of good feeling and a striking display of oratory.

The social features of the congress were most noteworthy. The president of the republic, besides giving the usual official reception, entertained the foreign delegates at dinner, invitations being extended to a limited number each day during the congress. Receptions were given under government auspices at the principal social clubs. The American Minister, the French, Brazilian and Argentine Ministers, and numerous prominent citizens entertained the delegates. Members of the American and other delegations were guests at a number of charming haciendas in the vicinity of Santiago; and the American delegation entertained at dinner members of the organization committee, chairmen of various national delegations and others. Visits were made to institutions of learning, museums, art galleries, hospitals and manufacturing establishments, and no effort was spared by the officials of the congress to make the visit of the foreign delegates enjoyable and profitable. The writer wishes to express his personal appreciation of these courtesies of their problems, and be certain to receive the best expert advice. Then, and not till then, shall we have developed a real continental spirit; then, and not till then, shall we have fulfilled the obligations which our privileged position in the world's affairs has placed upon us. I can imagine no greater distinction for the next congress than the possibility of marking a further step in the development of this spirit of service and of continental solidarity.

And now, in closing, let me again extend the thanks of the delegation of the United States of America to you, the members of the organizing committee, for your broad grasp of the purposes of the congress and the skill with which these purposes have been made real and effective; to you, our colleagues, for your cordial reception of newcomers in your midst, and finally to the government and people of Chile for the warm-hearted hospitality which we have enjoyed.

sies and attentions, and to say that he approached South America somewhat oppressed by the thought that he should find himself a stranger in a strange land, but that, on the contrary, there was not a day of the two months spent in the Latin-American countries on which he was not made to feel entirely at home and among appreciative and generous friends.

The universal feeling at the close of the congress was that the meeting had fully justified the plans of its projectors; and the story is not entirely told when it is stated that the elaborate program, covering nearly every branch of science, was successfully carried out. The more thoughtful find in this and in kindred assemblages, much that is of significance for the future of the American republics. This congress was a decided step in the direction of bringing about a better understanding among the nations represented. It was a step toward a fuller appreciation of the common interests of each and every American nation. It was an appreciable forward step in the development of the means and methods of promoting the common interests of the continent. It was a step toward making the experience and the accumulated wisdom of each people represented the experience and wisdom of all. In the Section of Pedagogy, the best that has been developed in the theory and practise of teaching was made the common property of all the American republics. In the Section of Sanitary and Medical Science, the latest achievements of each nation in the battle with disease were made familiar to every participant. In the Section of Agriculture and Zootechny, steps were taken in the direction of properly utilizing and conserving the resources of the continent in these important realms. In the Section of Engineering, the best methods of overcoming the various physical obstacles to progress and of winning the riches of the earth, were

explained for the benefit of all America. In the Section of Government and Law, the principles of statecraft and the administration of justice were discussed for the benefit of every American government. In the Section of the Fiscal Sciences, practical methods of conducting the monetary affairs of the nations were presented and explained. And in every other branch of science, practical and abstract, the various forces and agencies that contribute toward progress and enlightenment were in a measure the subject of serious attention. The congress was an initial step toward making the best of all the peoples of the western hemisphere. It was an initial step in making the best, for to-day and for all time, of the resources of the continent. It was an initial step which in many ways must make for the peace and prosperity of the continent. It was a noteworthy step in conformity with manifest destiny as expressed in the phrase "America for Americans."

The success of the congress of 1912 depends upon the interest displayed in it by the scientific world, and on the support accorded by the Pan-American governments. The time is ample, and the appointment of an organization committee representative of a wide range of scientific interests is the first step in making the Washington meeting an event worthy of the nation and its capital.

W. H. HOLMES
BUREAU OF AMERICAN ETHNOLOGY

MARTIN HANS BOYE

DR. M. H. BOYÈ died at Coopersburg, near Bethlehem, Pa., on March 5, aged ninety-seven years. He was born in Copenhagen, Denmark, in 1812, and in 1832 was graduated from the University of Copenhagen and in 1835 from its Polytechnic School, studying under Oersted, Zeise and Fodchhammer. In 1836 he removed to Philadelphia and entered the University of Pennsylvania, studying chemis-

try under the late Dr. Robert Hare. He was graduated from the university as doctor of medicine, but never practised regularly. In 1838 he was appointed assistant geologist of the first geologic survey of Pennsylvania. In 1845 he was elected professor of natural philosophy and chemistry in the Central High School of Philadelphia and retained this position for fourteen years.

In 1839 he was associated with Robert and James Rodgers, in analyzing limestone, coal, iron ore, etc. While engaged in these analyses he discovered a new compound of platinum chloride with nitric oxide. Because of this discovery he was elected to the American Philosophical Society, and in 1840 helped to organize the American Association of Geologists. He was the only surviving founder of this association and of its successor, the American Association for the Advancement of Science, of which he was a fellow for sixty years. In 1848 he also discovered the first of the violent explosives, perchloric ether, which he proved was ten times as powerful as gunpowder. He also found a safeguard against its unexpected explosion by dilution with alcohol. He was thus an important pioneer in the field of smokeless powder.

Dr. Boyè was the author of many papers on scientific subjects. In 1845 he invented a process of refining oil from cotton. Heretofore the product refined was almost black and very thick. His method produced a bland and colorless oil adapted for cooking or for salad dressing. At the age of eighty-one Dr. Boyè made an extended trip to Alaska, and at the age of eighty-five visited Honolulu and witnessed the transfer of the Hawaiian Island to the United States.

In his will Dr. Boyè devised the sum of \$12,000 to the University of Pennsylvania Hospital.

THE DARWIN CENTENARY

THE council of the senate of Cambridge University reports that the committee appointed by the council has informed the council that in July of last year letters signed by the chancellor were sent to more than 300 universities, colleges, academies and other cor-

porate bodies inviting them to appoint delegates to attend the Darwin celebration from June 22 to June 24, 1909. In answer to these invitations more than 200 delegates have been appointed. Since the beginning of the year individual letters of invitation have also been sent by the vice-chancellor to certain distinguished men of science, benefactors of the university and others.

A letter containing an invitation to a banquet on June 23 has been sent to about 150 resident members of the university, including heads of colleges, officers, professors and readers, members of council, university lecturers, demonstrators and other teachers connected with biological departments, fellows of Christ's College, contributors to the volume of essays, "Darwin and Modern Science," to be published by the University Press, and a few others selected on account of their official position or because of their connection with biological science. It is proposed to hold the banquet in the new Examination Hall, and it is estimated that between four and five hundred of those who have been invited will be present.

It is proposed that a letter of invitation to the reception by the chancellor in the Fitzwilliam Museum, on June 22, should be sent by the vice-chancellor to every member of the electoral roll.

A copy of the provisional program has been sent to all delegates. The committee has furnished the council with an approximate estimate of the expense likely to be incurred in carrying out the program. This amounts to considerably more than £500, but it is hoped that it may be possible to provide the excess above that sum by private subscriptions, and the council does not therefore ask the senate to authorize the expenditure of more than £500 from the university chest.

SCIENTIFIC NOTES AND NEWS

THE many friends of Major J. W. Powell, both in this country and abroad, will be glad to learn that congress appropriated \$5,000 for the erection of a memorial to him, on the brink of the Grand Canyon of the Colorado which he explored.

DR. J. J. STEVENSON, who has recently retired from the active duties of the chair of geology at New York University, has gone to California. He expects to spend the summer in Europe.

MR. C. L. VAN DINE, Stanford, about 1900, late territorial entomologist of Hawaii, has been appointed special agent of the Department of Agriculture in charge of sugar-cane and rice investigations. Mr. David T. Fullaway, Stanford, 1908, his assistant, is promoted to be territorial entomologist of Hawaii.

PROFESSOR WM. W. PAYNE has resigned the directorship of Goodsell Observatory, Carleton College, and has retired upon the Carnegie Foundation. He retains charge of the observatory time service and is still owner, editor and publisher of *Popular Astronomy*. Dr. H. C. Wilson has been appointed director of the observatory.

MR. R. C. PUNNETT has been appointed superintendent of the museum of zoology, at Cambridge, in succession to Dr. S. F. Harmer, who recently accepted the keepership in zoology at the British Museum of Natural History.

M. DELAFOND will succeed M. Nivoit as director of the Paris School of Mines.

THE University of Edinburgh will, at the approaching spring graduation, confer the honorary degree of LL.D. on Professor Alexander Crum Brown, till lately professor of chemistry in that university.

DR. ADOLF FRANK, the eminent chemist, has celebrated his seventy-fifth birthday.

THE portraits of the following former vice-chancellors have been presented to the University of London, and have been framed and hung in the vice-chancellor's room: Sir John W. Lubbock, Sir John Shaw-Lefevre, Sir Edward Ryan, Sir George Jessel, Sir Julian Goldsmid, Sir John Lubbock (now Lord Avebury), Sir James Paget, Sir Henry Roscoe, Dr. A. Robertson (now bishop of Exeter) and Dr. P. H. Pye-Smith.

THE following fifteen men of science have been nominated by the council of the Royal Society for election to membership: Mr. E. C.

C. Baly, Sir Thomas Barlow, Bart., Rev. E. W. Barnes, Dr. F. A. Bather, Sir Robert A. Hadfield, Mr. A. D. Hall, Dr. A. Harden, Mr. A. J. Jukes-Browne, Professor J. G. Kerr, Professor W. J. Lewis, Professor J. A. McClelland, Professor W. McFadden Orr, Dr. A. B. Rendle, Professor J. Lorrain Smith and Professor J. T. Wilson.

MR. J. G. BARTHOLOMEW, head of the Geographical Institute, the map house of Edinburgh, has been elected an honorary corresponding member of the Société de Géographie of Paris.

THE Smith's Prizes at Cambridge have been adjudged as follows: H. W. Turnbull, B.A., Trinity College, for his essay "The Irreducible Concomitants of Two Quadratics in n Variables"; G. N. Watson, B.A., Trinity College, for his essay "The Solution of the Homogeneous Linear Difference Equation of the Second Order, and its Applications to the Theory of Linear Differential Equations of Fuchsian Type."

DR. FREDERIK VAN EEDEN, of Amsterdam, who twenty years ago established a successful clinic for the mental treatment of disease, is at present in this country.

DR. HUBERT LYMAN CLARK has sailed for Jamaica to make collections on the reefs at Port Antonio.

AT the last meeting of the Middletown Scientific Association Dr. W. G. Cady, associate professor of physics at Wesleyan University, gave a lecture on "Electrical Oscillations."

THE Chicago Chapter of the Sigma Xi Society held its winter meeting on March 9. Professor W. L. Tower presented a paper on "Some Effects of Changed Environment upon Evolution Processes." Nine new members were admitted to the society.

THE Lowndean professor at Cambridge, Sir Robert Ball, F.R.S., lectured on "Ancient and Modern Views of the Constitution of the Milky Way" before the Cambridge Antiquarian Society on March 1.

SIR VICTOR HORSLEY will deliver the Linacre lecture at St. John's College, Cambridge, on

May 6, the subject of the lecture being the "Motor Area of the Brain."

MR. HENRY BAUSCH, second vice-president of the Bausch and Lomb Optical Company, and especially interested in the department of microscopes and scientific apparatus, died on March 2, at the age of fifty years.

DR. HERMANN EBBINGHAUS, professor of philosophy at the University of Halle, founder and editor of the *Zeitschrift für Psychologie*, one of the most eminent German psychologists, has died at fifty-nine years of age.

THE death is also announced of Professor Victor Egger, professor of philosophy and psychology at the Sorbonne, and distinguished chiefly by his work in psychology.

AT the meeting of the National Academy of Sciences in April, 1908, as part of the movement for encouragement of cooperative research, a special committee was appointed on paleontological correlation consisting of Messrs. Walcott, Dall, Scott and Osborn. A grant of \$500 was voted from the Bache Fund. As chairman of the section of vertebrate paleontology Professor Osborn has secured the cooperation of a number of foreign and American paleontologists, including Louis Dollo, of Brussels; Eberhard Fraas, of Stuttgart; Charles Depéret, of Lyons; Ernst Koken and F. von Huene, of Tubingen; S. W. Williston, of Chicago, and W. B. Scott, of Princeton. The council of the New York Academy of Sciences has voted to cooperate in this work by the publication of a series of correlation bulletins. The first bulletin now in press contains a report of progress for 1908. The author of the second bulletin is Professor Dollo, who covers the succession of vertebrates in Belgium. The third covers the work of Santiago Roth on the succession of mammalian horizons in Patagonia.

THE U. S. Geological Survey in cooperation with the State Geological Survey has established at the College of Engineering, University of Illinois, Urbana, Illinois, a Mine Explosion and Mine Rescue Station. The purpose of the station is to interest mine operators and inspectors in the economic value of such modern appliances as the oxygen hel-

mets and resuscitation apparatus as adjuncts to the normal equipment of mines. The station also will concern itself with the training of mine bosses and others in the use of such apparatus. Its service is to be rendered gratuitously, and so far as possible, to all in Illinois, Indiana, Michigan, west Kentucky, Iowa and Missouri. The formal opening of the station is to constitute a part of the proceedings of a fuel conference which is to be held at the University of Illinois from March 11 to 13.

ON the first of March, Captain John Donnell Smith, of Baltimore, sent to the Smithsonian Institution the second consignment of his herbarium, consisting of more than seven thousand sheets of ferns. The entire herbarium, consisting of over one hundred thousand mounted plants, together with his botanical library of sixteen hundred volumes, was formally presented to the Institution in 1905.

A GIFT of £1,000 from Mr. C. F. Foster, and of a second £1,000 by Mrs. Rawlins, towards the intended new Archeological Museum, at Oxford, are announced. These sums, like further sums given by the Foster family, who have now subscribed £6,000, are given in memory of Mr. W. K. Foster.

IT will probably be arranged that members taking part in the meetings of the British Association at Winnipeg from August 25 to September 1, may travel at the single fare rate of £7 11s. for the return journey between Quebec or Montreal and Winnipeg. This also applies to side trips in eastern Canada, the local single first-class fare being charged for the round trip, and it holds good for the round trip to points west of Winnipeg, the return ticket to the Pacific Coast points permitting members to return by the Crows' Nest Pass route.

A JOINT resolution passed both houses of congress authorizing the secretary of state to issue an invitation for the eighth International Congress of Applied Chemistry, to be held in this country. All the national societies interested in chemistry, educational institutions, corporations, etc., have been invited

to send delegates to a meeting to be held at the Chemists Club on April 3, to form an organization.

At a meeting of the business committee and the German members of the International Cancer Research Association, held at Berlin, on January 4, it was agreed, on the proposal of Professor von Czerny, to convene a conference on cancer at Brussels during the exhibition in that city. The final decision was left to the board of directors, which will meet during the session of the German Surgical Congress at Berlin, April 14 to 18.

It is expected that the Antarctic exploring steamer *Nimrod* will return to New Zealand at the end of March or the beginning of April. The headquarters of the expedition are at Lyttelton, the port of Canterbury, in the South Island, and that will be the *Nimrod's* destination when she comes out of the Antarctic regions. It is possible, however, that she will touch at a more southern port before reaching Lyttelton. She may put in at Half-moon Bay, in Stewart Island, off the southern coast of New Zealand, or at the Bluff, the southernmost port on the mainland.

THE program of the Forest Club of the University of Nebraska for the second semester is as follows:

February 16—"The Commercial Forest Nursery," by Mr. L. O. Williams.

March 2—"Lumbering in Washington," by E. G. Polleys.

"Microscopic Study of Woods," by G. N. Lamb.

March 16—"Factors Affecting Stream Flow," by Dr. Condra.

March 30—"Formation of Forest Soil," by Professor Barber.

"Moisture Studies in Forest Soils," by Professor Keyser.

April 27—"Scientific Problems in Forest Plantations," by Professor Phillips.

May 11—"State Problems in Wisconsin," by A. G. Hamel.

"Utilization in Wisconsin," by J. C. Ketridge.

May 25—"Forest Types in the Philippines," by G. Pagaduan.

"Forest Utilization in the Philippines," by M. Lazo.

By signing the bill for the creation of the Calaveras National Forest, California, President Roosevelt has completed the legislative act which saves the most famous grove of trees in the world. The first Calaveras bill was introduced in the senate four years ago by Senator Perkins, of California. Bills for the same purpose were passed in the upper house of Congress a number of times, but failed of favorable consideration in the house. There is to be a practical exchange of the timber in the groves for stumpage on other forest land owned by the government. The land to be acquired under the bill includes about 960 acres in what is known as the North Calaveras Grove in Calaveras County, and 3,040 acres in the South Grove in Tuolumne County. The North Grove contains ninety-three giant sequoias and in the South Grove there are 1,380 big trees. Any tree under eighteen feet in circumference, or six feet through, is not considered in the count of large trees. Besides the giant sequoias there are hundreds of sugar pines and yellow pines of large proportions, ranging to the height of 275 feet and often attaining a diameter of eight to ten feet. There are also many white firs and incense cedars in the two tracts. The North Grove contains ten trees each having a diameter of twenty-five feet or over, and more than seventy having a diameter of fifteen to twenty-five feet. Most of the trees have been named, some for famous generals of the United States and others for statesmen and various states of the union. "The Father of the Forests," now down, is estimated by Hittel, in his "Resources of California," to have had a height of 450 feet and a diameter at the ground of more than forty feet when it was standing. "Massachusetts" contains 118,000 board feet of lumber; "Governor Stoneman" contains 108,000 board feet, and the "Mother of the Forest," burned in the terrible forest fire which licked its way into a part of the grove last summer, contains 105,000 board feet. Each of these trees named grows as much lumber as is grown ordinarily on fifteen or twenty acres of timberland. The bark runs from six inches to two feet in thickness.

It is said that the Ohio State legislature once passed a bill establishing the value of π to accord with the views of some circle-squarer. It is perhaps scarcely fair to put in the same class the bill now before the British parliament. This bill "to promote the earlier use of daylight in certain months yearly"—formerly known shortly as the Daylight Saving Bill—is down for a second reading in the House of Commons. The operative clauses of the bill, as summarized in *Nature*, are as follows: (1) From two o'clock in the morning Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of *the third Sunday in April* in each year until two o'clock in the morning, Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of *the third Sunday in September* in each year the local time shall be in the case of Great Britain one hour in advance of Greenwich mean time and in the case of Ireland one hour in advance of Dublin mean time, and from two o'clock in the morning Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of *the third Sunday in September* in each year until two o'clock in the morning Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of *the third Sunday in April* in each year the local time shall be in the case of Great Britain the same as Greenwich mean time and in the case of Ireland the same as Dublin mean time. (2) The time hereby established shall be known as summer season time in Great Britain and Ireland, and whenever any expression of time occurs in any Act of Parliament, deed, or other legal instrument, the time mentioned or referred to shall, unless it is otherwise specifically stated, be held in the case of Great Britain and Ireland to be summer season time as prescribed by this Act. (3) Greenwich mean time as used for the purposes of astronomy and navigation shall not be affected by this Act. (4) This Act shall apply to the United Kingdom of Great Britain and Ireland, and may be cited as the Summer Season Time (Great Britain and Ireland) Act, 1909.

THE Dove Marine Laboratory at Cullercoats, which is to be occupied as a department of the Armstrong College, Newcastle-on-Tyne, was opened on December 29 by the Duke of Northumberland. From the account in the London *Times* we learn that the new building, which stands on the site of the old baths, contains an aquarium 30 feet by 23 feet, and there are 11 fish tanks. There is also a private aquarium, and provision is made in 36 tanks for the storing of materials for the workers for experiments, hatching and the like. Against the west wall is a concrete tank holding 15,000 gallons of salt water, which will give a continual flow through the various tanks, etc. In the center of the west gable is the coat of arms of the Hudleston and Dove families, and a polished granite tablet near the entrance bears the inscription: "Erected A.D. 1908 by Walter H. Hudleston, M.A., F.R.S., for the furtherance of Marine Biology and as a Memorial of his Ancestress Eleanor Dove." Mr. W. H. Hudleston, the donor of the building, presided. The Duke of Northumberland congratulated the people of Cullercoats on the new laboratory. He said there was one at Plymouth, one at Port Erin, in the Isle of Man, one in Lancashire, and three in Scotland, and the new building opened that day enabled them to fill up the gap. If they were to study the habits of fish and to give advice to those engaged in the industry, it was absolutely necessary to have these laboratories scattered up and down the coast. The county council of Northumberland was willing to contribute £100 per annum to that institution. It was willing to do more and to double that amount if the borough of Tynemouth came forward and subscribed £50. The duke paid a tribute to the generosity of Mr. Hudleston and to Professor Meek, who is to have charge of the laboratory.

AT the thirty-first annual general meeting of the Institute of Chemistry, held at 30, Bloomsbury-square, W. C., Professor Percy F. Frankland, the retiring president, in the course of his address, said, as reported in the

London Times, that the roll of the institute had increased by 78 fellows, 30 associates and 68 students, and, notwithstanding the increasing stringency of the regulations, the number of candidates for examination had increased from 94 in 1906 to 150 in 1909. He believed these figures indicated that a real advance was taking place in the demand for highly-trained chemists. It was one of the chief duties of the institute to maintain a high level of training for professional chemists by demanding of candidates for its membership evidence of thorough training, and by requiring them to pass searching examinations. He yielded to no one in the advocacy of research as a part of training; there was however much training in originality of thought and experimental procedure which was not called research and much of what was called research that involved no originality in the thought or deed. He then stated that a special committee had been discussing the arrangements to be made in view of the approaching expiry of the lease of the present premises of the institute and had come to the conclusion that between £10,000 and £15,000 would have to be raised by voluntary contributions in order to provide even a modest but dignified home in which the institute could carry on its work. Dr. George Beilby, F.R.S., was elected president.

THE Colorado Desert, in southern California, is one of the most interesting and one of the most nearly rainless parts of the United States. It lies in a wide valley, the northwest extension of the great depression at whose south end is the Gulf of California. Before the overflow of Colorado River into the Salton Sea, which began about five years ago, this basin was, with the exception of Death Valley, the lowest dry land in the United States. It is also the hottest place in the country, according to the official records. Parts of the desert are wastes of shifting sand, kept in almost constant motion by strong winds. Other parts, on the borders of the Salton Sea, contain strongly alkaline areas, and in some places now covered by that sea large quantities of salt have been mined.

South of the Salton Sea, in the Imperial Valley, the soil consists of fine silt, deposited in past centuries from the overflowing waters of Colorado River. This part of the area is the scene of the spectacular and almost uncontrollable overflow which was the occasion of a special message from the President to Congress and which was closed after repeated failures only in 1907, by the Southern Pacific Company. Toward the north end of the valley in which this desert lies, for the most part below sea-level, is the Indio region, or the Coachella Valley, where underground waters have been utilized for irrigating several thousand acres of fertile land. Melons, barley and alfalfa are extensively grown on large areas, and smaller tracts have been planted in oranges, grapes, sweet potatoes and sugar beets. Date palms have been planted also, and on the agricultural experiment station farm at Mecca rare varieties of luscious dates, which heretofore have been produced only in the Arabian deserts and in the oases of northern Africa, are grown successfully. A report on the Indio region, including a sketch of the Colorado Desert, prepared by W. C. Mendenhall, has just been published by the U. S. Geological Survey as Water-supply Paper 225, which may be had free on application. The report includes a description of the geography and geology of the Colorado Desert and an account of the underground waters of the Indio region, and is illustrated by maps, sections and reproductions of photographs of interesting features of the country.

UNIVERSITY AND EDUCATIONAL NEWS

THE passage of the legislative appropriation bill carrying \$982,000 for the University of Kansas, gives the university all it asked, excepting an appropriation for a dormitory.

By the will of Ellen A. Kendall, her residuary estate is given Wellesley College to found a professorship bearing her name. It is provided that if the fund exceeds \$60,000 the income of the excess shall be used to aid worthy students.

THE final settlement of the estate of Archibald Henry Blount, of England, who sometime ago made Yale University his residuary legatee, shows that the university will receive net from the estate the sum of \$328,752. In the settlement of the estate there has been paid out \$8,539 for the university's legal expenses in the matter, and about \$70,000 as an inheritance tax to the English Government.

THE Ontario legislature has passed a resolution permitting Toronto University to take advantage of the Carnegie Foundation's pension fund. The legislature of Nebraska has refused permission to the state university.

It is announced that Columbia University will establish a course in forestry leading to the degree of forest engineer. The plan will probably be put into effect next year though the special work would not begin for two more years.

A BILL has been introduced in the New York legislature amending the educational law by providing for the establishment of a State School of Sanitary Science and Public Health at Cornell University.

THREE departments of Sibley College, Cornell University—those of marine engineering, naval architecture and railway mechanical engineering—have been discontinued. This action has been nearly coincident with the departure from Cornell of the heads of two of the departments, Professors C. C. Thomas and H. Wade Hibbard. But these professors did not go because their departments had been or were to be abolished, nor was their departure the cause of the termination.

THE academy in Neuenburg, Switzerland, is to become a university.

THE Egyptian government has in view the establishment of a national university. The theological students at Cairo have recently petitioned for competent teachers of modern science.

At a recent meeting of the faculty of Wesleyan University, two committees were appointed to act with those of the trustees. One in regard to the establishment of a separate college for women has Professors Rice, Win-

chester, Harrington, Nicolson and Bradley as members; the other, which will help fix the date of the inauguration of President Franklin, consists of Professors Rice, Winchester and Crawford.

ACCORDING to the *Umschau* there are this semester 1077 regularly matriculated women students in the German universities as compared with 140 three years ago.

AT the meeting of the board of trustees of Stanford University, on March 5, the following promotions in rank to take effect with the beginning of the academic year 1909-10 were made: To the rank of professor: Frank Mace McFarland, in histology; John Flesher Newsom, in mining; Harold Heath, in zoology; Arthur Martin Catheart and Wesley Newcomb Hohfeld, in law; James Farley McClelland, in mining engineering; Guido Hugo Marx, in machine design; Henry Waldgrave Stuart, in philosophy. To the rank of associate professor: Karl G. Rendtorff and William Alpha Cooper, in German; Lillian Jane Martin, in psychology; Raymond Macdonald Alden, in English; William Rankine Eckart, in mechanical engineering; Halcott Cadwalader Moreno and Sidney Dean Townley, in applied mathematics; Charles Andrews Huston and Joseph Walter Bingham, in law. To the rank of assistant professor: Payson Jackson Treat, in history; Mary Isabel McCracken and Rennie Wilbur Doane, in entomology; Walter Kenrick Fisher, in zoology; James Pearce Mitchell, in chemistry; Leonas Lancelot Burlingame, in botany.

DR. R. S. WOODWORTH, adjunct professor of psychology in Columbia University, has been promoted to a professorship of psychology. Mr. H. H. Woodrow has been appointed tutor in psychology at Barnard College.

DR. LUDWIG MESSEY, associate professor of philosophy at Giessen, has accepted a call to the University at Buenos Ayres.

DISCUSSION AND CORRESPONDENCE ADULTERATION AND THE CONDITION OF ANALYTICAL CHEMISTRY AMONG THE ANCIENTS

IN an address of Mr. W. D. Richardson published in SCIENCE last year, attention is called

to the very speculative condition of ancient science. Mr. Richardson remarks that "Ancient records and books are extremely few in number, and worse than that, the scientific writings, when they are not purely speculative, are quite unreliable." This statement, while undoubtedly true, in a certain sense seems to me open to criticism in that it is apt to give one an entirely mistaken idea of what classic writers have recorded regarding the achievements of the ancients in practical chemistry. As a matter of fact, enough reliable practical chemical knowledge has come down to us in the writings of Pliny, Dioscorides and others to form a very respectable treatise. The "Natural History" of Pliny, for example, is completely interwoven with little digressions upon what is now termed the "chemistry of every-day life" and the reader is often surprised to run across statements, which might have been taken from some modern work, such, for example, as references to the use and well-recognized efficiency of burning sulphur for fumigating and purifying the interior of dwellings (book 25, ch. 50), or to the use of suspended cords upon which to crystallize substances (book 34, ch. 32), or to the lowering of a burning light into wine vats to determine whether or not it was safe for workmen to descend in order to remove the lees. "As long as the light refuses to burn it is significant of danger" (book 23, ch. 31). Pliny's book is filled with such little practical points as these, all of which, together with his description of many technical processes in which the Romans were recognized masters, such as the mixing of mortars and cement, the manufacture of white lead and other pigments, the fermentation of wine, the use of legumes in crop-rotation, etc., serve as a most striking commentary upon the manner in which the practise of a science may anticipate the dictates of its theory—even by thousands of years. Much of the matter which Pliny has gleaned in his "Natural History" was common knowledge centuries before his time. The use of burning sulphur as a disinfectant, for example, is mentioned in the "Odyssey" of Homer (book 22, ch. 481). Odysseus, after

the murder of the suitors, cries out to his aged nurse: "Bring sulphur, old woman, the cleanser of pollution and bring me fire, that I may sulphur the chamber."

The science of the ancients was extremely weak, however, upon its analytic side and in the course of its whole history may be said to have produced but one mind truly great in this respect—that of Archimedes. This philosopher and experimenter by his method of displacement was the first to establish a physical constant—that of specific gravity—and the first to apply such a constant to certain analytical problems as in the well-known example cited by Vitruvius, where Archimedes determined the purity of the gold in King Hiero's votive crown.

The application of specific gravity to the testing of various bodies, liquid as well as solid, seems to have been common after the time of Archimedes. Pliny (book 31, ch. 23), in fact, alludes to the use of some form of specific gravity balance (Statera) by which the purity of water could be tested.

The search for a means to detect adulteration was what led Archimedes to his epoch-making discovery and this we will find to be always a leading stimulus in the development of analytical chemistry in ancient as well as in modern times. The adulteration of foods and other commodities of life was as common in the early days of the Roman Empire as it is to-day. Pliny repeatedly calls attention to the many frauds of his time. "It is the natural propensity of man to falsify and corrupt everything," he exclaims while writing of the adulteration of honey, and again, when speaking of the use of gypsum, pitch, lime, rosin, wood ashes, salt, sulphur, artificial pigments, etc., for treating wines (book 14, ch. 25), he cries out: "By such poisonous sophistications is this beverage compelled to suit our tastes, and then we are surprised that it is injurious in its effects!" Pliny blames the druggists especially for their practises in this respect and is most bitter in his denunciations of the whole fraternity of Roman apothecaries. Many pages of the "Naturalis Historia" are in fact devoted to the disclosure of the

"shady" practises carried out in the shops of the ancient druggists (*tenebræ officinarum*).

In the long list of tests, which Pliny enumerates for detecting the various forms of adulteration practised in his time, by far the greater number relate to the use of our simplest sense perceptions, such as taste, smell, color, feel, brittleness, etc. The ancients guided by such perceptions were unquestionably better judges of the purity of many articles of food than we are to-day. Pliny in fact, makes such a fine classification of tastes and flavors (book 15, ch. 32) that the translator finds himself at a loss for suitable terms in which to express the meaning. Whether this indicates an over-refinement of the taste perception among the Romans through the influence of a long line of epicures dating from Lucullus, or simply an atrophy of our present powers in this respect, would be difficult to say. Professional tasters (book 14, ch. 8) were in demand during the early days of the Roman empire to determine the quality of wines, and notwithstanding our advanced chemical knowledge of the score or more esters which give wines their characteristic bouquet, the final criterion in the judgment of a wine, now as in the days of Pliny, is the evidence of a skillful taster.

But the ancients had many other means of testing the purity of their commodities of life than those of simple taste and smell; and it is worth our while to examine a few of these, for they mark in reality the first beginnings in the development of the science of analytical chemistry. A good illustration of such tests is given under Pliny's description of Balsam (book 12, ch. 54).

Balsam in a genuine state should be quite hard, but when it is mixed with gum a brittle pellicle forms upon it. The fraud can also be detected by the taste and when placed upon hot coals it may easily be seen if there has been any adulteration with wax and rosin, for the flame in this case burns with a blacker smoke than when the balsam is pure. In addition to these various tests a drop of pure balsam, if placed in luke-warm water, will settle to the bottom of the vessel, whereas, if it is adulterated it will float upon the surface like oil, and if it has been drugged with metopion or am-

moniacum, a white circle will form around it. But the best test of all is, that it will cause milk to curdle, and leave no stain upon cloth.

Such tests as the ones cited in this quotation show that the faculty of careful and precise observation was by no means neglected among the ancients.

The flame test to which reference was made, is mentioned repeatedly by Pliny in the testing of drugs and chemicals. In some cases the color and smell of the smoke were observed, in others the color of the flame, or the property of decrepitating.

The formation of a white ring as described by Pliny in his test for adulterated balsam, brings up to the mind of the chemist the innumerable ring tests which are made use of in the laboratory at the present day, as well as the host of color reactions employed in testing food products, drugs and chemicals. We find, in fact, that these color reactions were used very extensively by the ancients, and the mention of one or two others may have a passing interest.

Among the tests given for alum Pliny (book 35, ch. 52) states that it will turn pomegranate juice and nut galls black. Authorities differ somewhat as to the exact nature of the compound that was called alumen by the Romans and *στυπτηρία* by the Greeks, but all seem agreed that sulphate of iron was present. The tests which Pliny describes are therefore nothing but the familiar tannin reaction with salts of iron.

A most interesting modification of the nut-gall test is described under the subject of verdigris (book 34, ch. 28). Here a piece of papyrus, which had been previously steeped in an infusion of nut galls, is employed for testing, the paper so treated turning black if genuine verdigris is applied. This passage is noteworthy, for so far as I can find it is the first historical reference to the use of test paper.

In a number of instances I have found Pliny to be even wiser than his modern commentators. Pliny gives, for example, as one of the tests for vinegar (book 23, ch. 27) that it has the property of effervescing when poured upon the ground. The editor of one

translation remarks as to this that the vinegar of the present day does not have any such property. If this commentator, however, had had even a little knowledge of chemistry, he might have remembered that the acid of vinegar may cause a considerable effervescence of carbonic acid when brought into contact with chalky or calcareous soils.

In testing the purity of minerals and precious stones the ancients seem to have acquired considerable dexterity. The use of the touch-stone (*Coticula*) for determining the purity of precious metals and their ores was well known to the Romans and employed with such accuracy, according to Pliny (book 33, ch. 43), that the proportion of gold, silver or copper could be told instantly, even to the smallest fraction. In detecting the imitation of gems and precious stones—concerning which Pliny (book 37, ch. 75) states that most colossal deceptions were practised and in no other kind of fraud greater profits made—the ancients were in many ways as skillful as the jewelers of to-day. They employed the balance, tested certain optical properties, and even used a scale of hardness (book 37, ch. 76), it being recognized that some stones could be scratched with a blunt knife, while others could not be marked with the hardest obsidian.

Lack of space forbids giving other examples of the methods employed by the ancients in testing the purity of the commodities of life. The examples cited however show that the fragmentary records of ancient science preserved by Pliny, full as they are of inaccuracies and absurdities, contain a large amount of reliable chemical knowledge. And if the 474 authors whom Pliny consulted in the preparation of his "History" had come down to us intact we may be sure that our knowledge not only of historical, but also of practical, chemistry would be greatly enriched.

C. A. BROWNE

NEW YORK

EVOLUTIONARY COLLECTIONS AS MONUMENTS TO DARWIN

To THE EDITOR OF SCIENCE: In connection with the recent announcements that special

collections in honor of Darwin are to be formed at the American Museum of Natural History, and that Haeckel intends to devote the remainder of his life to his phylogenetic museum, I venture to call attention to the subjoined selections from my address, "Educational Museums of Vertebrates," before the Biologic Section of the American Association for the Advancement of Science in 1885 (see the *Proceedings*, vol. 34, and abstract in SCIENCE, September 11, 1885):

A statue of Darwin has been unveiled in London with honorable ceremonies. What monument to his memory could be more appropriate or lasting than the formation, in all educational institutions, of collections especially designed to exhibit the facts which he made significant, and the ideas which his knowledge, his industry and his honesty have caused to underlie the intelligent study of nature throughout the world. Such collections should particularly embrace series illustrating human peculiarities, not only as to skeleton, but as to brain, heart and other organs; human resemblances to mammals in general; features that unite man with the tailless apes, and separate them from all other mammals; transitory human organs and conditions that resemble the permanent organs and conditions of other mammals, especially apes; human anomalies resembling the normal structure of apes; anomalies and malformations affecting man and other vertebrates in a similar manner; apparently useless or detrimental organs or conditions.

BURT G. WILDER

ITHACA, N. Y.,
February 13, 1909

QUOTATIONS

THE FUTURE OF YALE

IF I were president of Yale! But that is inconceivable. I was never in the hereditary line of descent. Besides I stepped out of all other lines that tend toward New Haven when, forty years ago, after getting more or less ready for Yale, I went as a pioneer to untried Cornell. I went because botany and geology and European history at Cornell counted for as much as Latin or Greek; and now I have to take the consequences.

If I were president of Yale, and had the necessary power and the necessary backing, this I would surely do. I would make it Yale College or else Yale University. For the questions would lie heavily on my conscience—Should a boy go to a university for college work? Should a man go to a college for university work? Should a school for boys try to teach also men? Should a school for men teach also boys, under the same conditions and regulations, and with the same teachers?

I read not long since a well-written book, "What College for the Boy?" In this volume, Yale College receives favorable mention, and most justly. Can I imagine a cognate volume in Germany? "Welche Universität fur den Knaben?" The very title is absurd on the face of it, for the place of "Knabe" is not in the "Universität." Conversely, the function of a university is not to teach the boy but the man.

The name "university" has in Germany and in continental Europe a fairly definite meaning. In America, it means nothing in particular, except a higher school, higher than the high school. In England it often means still less—an examining board authorized to confer degrees. Let us take the German meaning—a school for men, who have finished their general culture, have ceased to be boys, and have begun preparations for life work as professional men, as teachers or as investigators. This is the meaning Johns Hopkins has brought to America, and which is recognized as a valuable but exotic attachment at Harvard, at Yale and with the rest of us.

On the other hand, we have adopted the English term "college" for a group of schools progressively diverging from the English standards, but which agree in this. Their first function is to make men out of boys, and to secure the boys' cooperation and interest in the process. Where this is best done is in the "college for the boy." Where the demands of scholarship are most strenuous, where expeditions are constantly undertaken for the conquest of the unknown, where books, apparatus and collections are greatest, that is the university for the man.

In this transition stage, we have lost sight of both ideals. Rather, we behold one of them for a time, then the other, and we rush like a school of herrings toward the light that we see for the moment.

A few years ago, almost every college pretended to be a university. Almost every college teacher thought himself engaged in research and pretended to hold in contempt the "boy" and all his own duties toward the boy. So the boy became estranged from his work, and made trouble. Thus the college ideals are again insistent. Good teaching is again the demand, and the tireless attention to details that make boy-training possible, and which shut out the teacher from research of any intensive character.

All honor to the college teacher who in all these years has never lost his head, and who has steadily, consistently and without self-compromise done his duty in making boys into men. He finds them just as plastic as they ever were, and his reward as ever is in the doing.

All honor to the university teacher who abates none of his ideals, who sees the universe with a keener eye than the rest of us, and who never forgets his first duty as a seer, a prophet, a founder of a school of thought, a leader of men.

The college and the university are here, are here to stay, and here to grow and develop; but not in the same space, and still less as, at present, telescoped together. Sooner or later, we must recognize the two different functions. Sooner or later we must see that the college with its boy's play, its foot-ball team, its glee club, its need of personal inspiration, its need of rigorous moral discipline, its need of absolute inhibition of vinous conviviality, its demand for insistent training rules to prevent grafting and dissipation, is an end in itself. The glory of Yale has been that of Yale College, and Yale will have fulfilled all that a nation can ask of it if it makes Yale College the culmination of its activities. Or, Yale University may be the glory of the future—the thorough professional and technical training of men already broad-minded, clean-souled, and well-

grounded in all that the college can give in its four years of fellowship, aspiration and discipline. (These four years ought to end as they did thirty years ago, with the year we now call "sophomore," but that is another story.) But Yale College and Yale University, all together and equally great, that can never be.

Yale University needs books, apparatus, collections, long-striding scholars and founders of dynasties of scholarship and research. Yale University needs millions; Yale College has enough. But Yale College and Yale University in one yard, under one body of teachers, under one set of discipline, and forever getting in each other's way; this condition can never be a finality. Until they are separated in space, as in time, Yale College can not escape the reproach all our colleges bear, that she neglects her boys in the imagined interest of research; that her professors do not love their work, and slight it in many ways; that if the boy becomes a man the college deserves no thanks for it.¹ On the other hand, Yale

¹ Says Dr. George E. Vincent, a dean of the University of Chicago: "The chief causes which are alleged to be responsible for a perceptible lowering of the standard of student work are: less definite and disciplinary instruction in the elementary and secondary schools; an elective system permitting a haphazard, desultory, individual course; the presence of an idle rich class setting a standard of ostentation and luxury; the exaltation of competitive athletics and the heroizing of successful athletes; the growth of fraternities with their time-consuming activities and social distinctions; the emphasis on social life and the consequent prejudice against the diligent student who takes little part in the 'valuable education outside the classroom'; the over-crowding of classes so that attention to individual students is difficult or impossible; the introduction of the lecture system for undergraduates accustomed to the drill of the recitation method; the putting of young, inexperienced, overworked and illpaid instructors in charge of freshmen and sophomore divisions; the competition between instructors in offering popular, largely elected, and too often 'snap' or 'soft' courses; the exaltation of research at the expense of 'mere teaching' and the consequent lowering of teaching efficiency; the extension of the doctrine of freedom

University will find itself blamed for contributing so little to the advance of knowledge. With a staff as large as that of Leipzig, more or less, and an equivalent student body, its scholarly output is less than half that of the German institution. This sort of criticism we hear again and again. Whether this be just or not is a minor question. People think that it is true, and it will be essentially true so long as Yale College is interchangeable with Yale University.

Were I president of Yale, I would cling to the one ideal or the other, letting all else go. For the time must come when our colleges can not fulfill our university ideals, by adding scantily equipped professional schools and hiring a dozen or two graduate students to shift for themselves under overworked professors. Meanwhile, our universities can not make men out of boys unless they address themselves most seriously to the business, "bringing every ray of various genius to their hospitable halls" that through their united influence "they may set the heart of the youth in flame."

You will see that this applies to Yale no more and no less than to Harvard, to Cornell, to Wisconsin and to any other institution which is trying to do boy's work and man's work at the same time, in the same place, and by the same educational machinery. We have just now referred to the University of Leipzig. Let us suppose that to her three thousand students, more or less, she should add as many more from the higher grades of the gymnasium or high school, corresponding to our freshmen and sophomores. Let us suppose that she should add to her faculty of three of teaching to protect a careless or inefficient instructor of elementary courses from investigation; failure to make college work seem vital to the student, a means to his personal ends, in marked contrast with the success of the professional schools which hold up a definite goal, arouse interest and enforce a higher standard of effort and accomplishment. The mere enumeration of these charges raises many questions of fact and interpretation. That some if not all of the influences are present in all of our colleges is not to be denied."

hundred professors, more or less, as many gymnasium drill masters. Let us suppose that the resultant multitude were called a university. It would be just the same sort of a university we have developed in America, a place where men and boys are gathered together, each in the other's way, and where neither ideals of scholarship nor ideals of man-making can reach their most perfect achievement.—President David Starr Jordan, in *The Yale News*.

SCIENTIFIC BOOKS

Conditions of Life in the Sea. A Short Account of Quantitative Marine Biological Research. By JAMES JOHNSTONE. Pp. 332. Cambridge Biological Series, Cambridge University Press. 1908.

Many good things must be, and a few bad things ought to be, said about this book. Since it is more agreeable to speak well than ill, we will occupy ourselves first and chiefly with what is good.

The broader value of the work is two fold. In the first place it affords an easy, reliable opening into an important, rapidly growing field of knowledge that hitherto has not been readily accessible to general readers, nor indeed to special scientific students. The field to which reference is made is marine biology as developed particularly by the countries bordering on the North Sea. Many professional biologists, especially in America, have not yet had brought home to them the fundamental nature of various conceptions and methods involved in these investigations.

In the second place the book is noteworthy for biology generally from the consistency with which the quantitative standpoint is maintained. The reviewer does not recall another semi-popular work in which organisms are regarded in a quantitative way for so wide a range of their relationships. In this the book may be looked upon as a harbinger of what biological treatises of general character will be in the future. This statement tells at once that the author is enrolled in the so-called Hensen or Kiel school of marine biologists.

Much criticism has been passed upon both

the methods and results of this school. One may be indeed justifiably sceptical concerning the value of the particular calculation that a square mile of the water of the Baltic Sea contains 80 to 100 billion copepods, or that there were 180,139,000 haddock in the whole North Sea during the spring of 1895. The chief interest in the calculation lies in its significance concerning what biology's attitude toward its problems may be. In a given limited area of the ocean, the North Sea for example, there is at a given time some limited number of haddock. Finite quantities of substances and bodies and forces are the very foundation stones of all physical science, biology with the rest, and sooner or later as knowledge advances, values for these quantities are bound to be sought. When fishing industries unite with clearly perceived biological problems in demanding information as to how many herring there are in the North Sea, and how much food is available for them, to get such information is exactly part of the business of science. If the first attempts are not sufficiently reliable, others with better methods must be made. For biology to take the ground that such researches can not be successful, nor would be significant if they were, would be to acknowledge itself stunted in its early youth.

The book is divided into three parts. Part I. designated introductory, contains in the first place a general description of the apparatus and procedures used in the most advanced marine biological researches. An account of certain aspects of oceanography is also given as is a very general survey of the Life of the Sea. Such topics as bottom deposits, composition, temperature, transparency and circulation of the waters are touched upon.

Under the heading Life in the Sea the zones of littoral life, bottom dwellers, or the benthos, and the free life, or the nekton and plankton, and kindred subjects are spoken of and several figures showing characteristic pelagic invertebrates and algae are given. This part ends with a chapter on sea fisheries.

The real essence of the volume is in parts II. and III., designated respectively Quantitative

tative Marine Biology and Metabolism of the Sea. Part II. is, on the whole, the most satisfactory portion of the book. The author is at his best when dealing with actual observations and matters of fact in such a way that his general biological theories have no visible influence on his conclusions, and it is unfortunate that the whole book could not have been written with a mind thus unhampered.

Although Mr. Johnstone's adherence to the Hensen ideas is unqualified it is not slavish. Most, though by no means all, of the more telling criticisms passed upon the methods and results of the Kiel school are duly heeded. The methods of collecting developed up to date are treated to the extent of nearly ten pages, and Lohmann's interesting observations on the capture of plankton by appendicularia is adequately noticed. The four methods of estimating the quantity of plankton, viz., the volumetric, chemical, gravimetric and numerical, are considered both as to processes and reliability. Of these "the actual counting of the organisms is the most satisfactory."

The surface distribution of certain kinds of planktonic organisms in the north Atlantic is illustrated chiefly by reference to Cleve's work. Two instructive charts accompany this discussion.

A chapter devoted to A Census of the Sea, and another on The Productivity of the Sea, summarizes considerable of the data on these subjects, though by no means all that has been gathered by the investigators of the north Atlantic.

On the question of the depletion of the sea through fishing, the author, though admitting the absence of conclusive proof on either side, and noting the authoritative opinion against exhaustion, thinks "we can not come to any other conclusion than that fishing operations as at present carried on, do cause a very appreciable diminution of the stock of fish on the sea bottom." More reliance is placed on Hensen's investigations than on any others for this conclusion.

Greater productivity of the ocean in high latitudes than in low is regarded by the author as proved. The three chief explanations

of this supposed fact are considered in part III. Brandt's conjecture that denitrifying bacteria are more active in warmer waters and hence prevent these from containing as ample a supply of nitrogenous food-salts for the phyto-plankton as the colder waters have, is held to be "not the only hypothesis capable of explaining" the phenomenon. Nathanson has suggested that in some localities at least, colder waters may contain greater quantities of organic matter because they have up-welled from the bottom or deeper water where such matter has gradually accumulated through the settling into them of the carcases of organisms that have lived in the lighter waters above; or through the transference to them by convection-currents of warmer surface water from middle latitudes that have been enriched in organic matter by rivers from land areas clothed with vegetation of tropical luxuriance. Johnstone thinks this hypothesis worthy of consideration.

Finally the explanation proposed by Pütter is presented. This author supposed, to state the case in a nutshell, that animals inhabiting warm waters live faster than those inhabiting cold waters and so consume more food. Consequently since the food supply is everywhere limited, a less numerous population can be maintained in the warmer than in the colder seas.

Among the many interesting subjects treated in part III., none is more interesting than that of nitrogen in the sea and the relation of bacteria to this element.

That imagination would be dull indeed that should not be kindled by the picture outlined in this part of the book of what the earth really is as a habitation for living beings. The truly cosmic character of the problems the threshold of which has been crossed by Brandt and the few other foremost investigators in this realm, is well brought home to the reader.

The book ends with several useful appendices, one of which is a summary of A. B. Macallum's interesting though not convincing speculations on the chemistry of the early seas, and the impress this has left on living beings down to even the present.

It remains now to point out certain really bad defects in the work. In the first place the title is misleading. From it a prospective reader would anticipate a comprehensive treatise—comprehensive, that is, in the sense of reaching to the seas of the earth generally. As a matter of fact the only indication the book contains that the author knows of the existence of oceans beyond that contiguous to northwestern Europe is just enough reference to others to impress the reader with the idea that whatever such there chance to be, may be ignored, except so far as they illustrate the central truths, truths, that is, that center in the North Sea. Think, for instance, of a discussion of "The Productivity of the Sea" that does not mention the cod-fisheries of Newfoundland, the salmon-fisheries of Alaska, and the fisheries generally of Japan and China!

How shall a professedly general treatment of the problem of the depletion of the sea be characterized that makes no reference to the Alaskan salmon hatcheries or to the perennial effort to save from destruction the fur-seal herds of the Behring Sea?

Had the author taken as his title "Conditions of Life in the *North Sea*" or something of the sort, he would have saved himself from the grave criticism that must now be passed upon him. Any moderately informed reader will surely ask: Does the author not know what has been and is being done in other parts of the world on many of the problems considered, or knowing does he deliberately ignore? Desiring to be fair which alternative shall we reject as being the less creditable?

Is an author's deficiency professional or ethical, which permits him to discuss in a general book the "Stratifications of the Plankton" and make no reference to the work of Alexander Agassiz?

Professor W. A. Herdman and his colleagues of the Marine Biological Association of Liverpool have contributed importantly to the knowledge of the sea and its life, particularly of the western British seas. Does Mr. Johnstone find nothing here deserving

mention beyond the fact of footnote value (p. 191), that Herdman has made "some interesting suggestions as to the use of cope-poda as human food?"

Wherefore the book's deficiency in the use of accumulated knowledge? The candid, measurably informed reader is forced to this question over and over again.

Some of the chapters were turned over to the printer while their English was yet sorely in need of pruning and finishing.

On account of the limited amount of food yolk development is a rapid process and the little fish usually hatches out from the egg in a week or two, but is a very feeble and helpless creature (p. 83). (37 words.)

On account of the limited food-yolk development is rapid and the little fish usually hatches in a week or two, but is very feeble and helpless. (27 words.)

Ten useless words in thirty-seven are too many. They make twenty-seven per cent. of superfluity. On the score of mere physical loading this is unfair to the printer, the purchaser and the reader, to say nothing of the writer. Furthermore, there are the literary proprieties. Surely they deserve some consideration even at the hands of the scientific man. True no great number of sentences are as hypertrophied as is this, but it is by no means unique and those that approach it are not rare.

Despite these unsavory remarks brought upon itself, the book's merits far outweigh its defects. All English speaking people interested in the larger aspects of marine biology should feel grateful to Mr. Johnstone for having written it even though they can hardly help wishing he might have made it better in some respects.

W.M. E. RITTER

Manual of Practical Assaying. By the late H. VAN F. FURMAN, E.M. Revised and enlarged by WILLIAM D. PARDOE, A.M., Assistant in Mineralogy, Princeton University. Cloth, 8vo. Pp. xi + 497. Price \$3.00.

It was most gratifying to find that this book, which has been considered as a standard, and had been used extensively as a text-

book in nearly all our universities, was not to be permanently laid on the shelf. The friends of Professor Furman heard of his demise with the deepest regret, and it was with the greatest of pleasure that the writer learned that a lasting monument to his name was to be erected through the publishing of a sixth edition on "Assaying," revised and enlarged by Mr. W. D. Pardoe.

This book has been, and will continue to be, the standard on assaying for technical chemists, and for students in the universities which have a mining, metallurgical or any course on the quantitative determination of metals and their associated elements.

The aim of the author was to present to technical chemists and students of chemistry a *practical* book. That he succeeded is demonstrated fully by the demand for a sixth edition. In this book only the most approved methods of analysis have been chosen, and particular attention has been paid to rapid methods which are so indispensable to technical chemists employed on commercial enterprises. At the same time slower and more accurate methods are nearly always given, so that the analyst can use either, according to the dictates of the time at his disposal.

By the revision of the chapters on zinc, water and coal analyses, and the addition of methods for telluride ores, tungsten, molybdenum and vanadium, together with other minor changes, this book has been most thoroughly brought up to the present practise common in most of our large commercial laboratories.

The whole book is singularly free from lengthy theoretical discussions of the reactions taking place, but enough of the reasons "why" are given to enable the trained chemist to understand fully the methods he is pursuing. At the same time the chemist's assistant who may lack a college training can easily pick up "Assaying" and do good work if he follows carefully the very explicit directions.

If the writer may be allowed a word of friendly criticism, since the text is very clear and leaves little to be improved upon, it would seem in some cases as though this text

could have been supplemented to a very great advantage to the student if more diagrams and illustrations of apparatus had been interpolated. For example, a picture or diagram of the quite complicated apparatus, such as is used for the determination of total carbon in the analysis of iron and steel, would go a long way toward helping the beginner in quantitative analysis to fully understand its setting up.

But taken altogether, the book is most admirably adapted for the teaching of assaying in a practical way, and is a most desirable addition to the chemist's library, be he beginner or an expert.

HENRY C. BOYNTON

TRENTON, N. J.

A Study of Splashes. By A. M. WORTHINGTON. With 197 illustrations from instantaneous photographs. London and New York, Longmans Green & Co.

"This publication," as the author says in his preface, "is an attempt to present in a form acceptable to the general reader the outcome of an inquiry, conducted by the aid of instantaneous photography, which was begun about fourteen years ago. . . ."

Every observant person must have at some time or other been impressed with the curious appearance of the splashes produced by rain drops falling into still water: the small pits or craters with little fountains in their centers, which sometimes rise above the surface to the height of an inch or more, can hardly fail to have attracted the attention of every one. In this book we find a collection of some of the most interesting photographs ever obtained by the aid of instantaneous photography. It is a volume of interest to old and young alike, and should be in the hands of every boy interested in natural phenomena. Some of the phenomena recorded by the instantaneous flash of the electric spark can be seen by ordinary eye observation. If a drop of milk is allowed to fall from a height of fifteen inches into a cup of tea or coffee, to which milk has not been added, observation shows us that the white drop appears to penetrate a short distance.

into the dark liquid and then bounce out again. To find out what really happens we have only to inspect the photographs of the drop as it enters the liquid. It forms a hollow bowl or crater six or eight times its own size (in diameter), the milk flowing up the steep sides in radial streams; surface tension then pulls down the walls of the crater, the milk streaming back from all sides towards the center of the crater from which a fountain rises, carrying the reconstructed milk drop upon its summit.

Even more interesting is the study of the difference in the nature of the splash in the case of a highly polished marble and one which has had its surface roughened with sand paper. In the former case we have what Worthington has named the "sheath" splash, which is characterized by a very curious flowing up of the liquid around the surface of the sphere as it enters the water, the marble entering the liquid with little or no sound and the production of no bubbles. If the surface is roughened the liquid does not glide up the surface but shoots off tangentially to the sides, forming the "basket" splash, which is distinctly audible, and is followed by a violent bubbling of the liquid. The author advises every one to have a bag of marbles hung up in the bath-room, and repeat these experiments in the bath-tub. In addition to the wonderfully interesting photographs there is much valuable and entertaining descriptive matter, and the theory of the phenomenon of the splash is very fully discussed in its relation to surface tension, gravity, viscosity of the fluid, etc.

As the author points out a kinetoscope capable of securing a continuous series of pictures showing all of the various phases of a single splash is much to be desired. Such an instrument ought not to be difficult to construct. It would not be necessary to have the film brought to rest for each exposure, as is the case in the ordinary instrument, provided the illumination was effected by properly timed electric sparks. The most interesting stages of the phenomena are over in about two tenths of a second, and it would be necessary to secure about one hundred photo-

graphs during this space of time. When run through the machine at the rate of seven per second we should have a quarter of a minute to study the phenomenon. The sparks could be timed by putting a make and break in the primary circuit of an induction coil, so arranged as to be operated by the mechanism which carried the film along.

R. W. Wood

SPECIAL ARTICLES

A NOTE CONCERNING INHERITANCE IN SWEET CORN

IN the polymorphic species, *Zea mays* L., the sweet corns, called *Zea saccharata* by Sturtevant, have been considered as a single subspecies group characterized by a hard, translucent and more or less shriveled condition of the endosperm. Correns¹ has shown that this character is due simply to an inability to complete the formation of normal maize starch, and further, that the presence and absence of this starch-forming ability act as an independent character pair in inheritance. No other feature is peculiar to the group: varieties characterized by black aleurone cells, red pericarp, yellow endosperm and the other salient points common to dent and to flint corns, are all found in the sweet corns. Their claim as a subspecies group thus rests entirely on the first-mentioned character.

The following evidence, however, indicates that sweet corn varieties do not belong to a unit group, but consist both of dent corns and of flint corns which have lost their original starch-forming power. This condition may have come about through mutation in each of these groups, but from what we know of the early history of the sweet corns, it is more likely that the change took place among the flint types and was extended by hybridization.

The dent corns are distinguished by a cornous starchy part of the endosperm which lies at the sides of the kernel and surrounds

¹ Correns, C., "Bastarde zwischen Maisrassen mit besonderer Berücksichtigung der Xenien," *Bibliotheca Botanica*, 1901.

a zone of white starchy matter extending from the tip to the cap, where it forms a layer varying in thickness in different varieties. The shrinkage of this cap starch forms the indentation of the kernel. In the flint corns this soft starch at the cap is replaced by corneous starch, thereby giving the outer portion of the kernel a smooth appearance. Besides this absolute difference, most dent and flint varieties differ in other characters, although a few intergrading strains are found. In the first place, dent corns are found that possess from twelve to twenty-eight rows of kernels, while the older flint types have but eight rows. It is true that there are genuine dents and true flints that tend toward the production of twelve rows, but below this number with the dents, and above it with the flints, continual reverersions indicate a hybrid condition. Dent corns are little given to tillering, while with flint corns it is characteristic. This trait is partly a physiological reaction due to the greater amount of soil fertility required by the large main stalk of the dent varieties, and partly an inherent trait capable of hereditary transmission. Flint corns are further characterized by the manner in which the ends of the spathaceous bracts (husks) enclosing the pistillate flowers are expanded into leafy parts from one to two feet long. In the dent corns these appendages are absent or only slightly developed.

The bearing of these opposite features in the dent and the flint corns on the matter in hand, is that *sweet corn with its numerous varieties runs the whole gamut of these characters*. Stowell's Evergreen, a large sweet variety with from sixteen to twenty-four rows, is an example of a "dent" sweet corn, while the Golden Bantam and Black Mexican, two small eight-rowed varieties, are examples of "flint" sweet corns. These varieties are typically dent and flints, respectively, in every character except starchiness. Moreover, when the character of starchiness is brought into kernels of these varieties by pollination with either dent or flint pollen, the hybrid kernels formed are indistinguishable from pure dent and pure flint kernels, respectively. It seems to make no difference with either variety

whether dent or flint pollen is used, for, although the starchy character appears in the individual kernel as *zenia* through double fertilization, the dent and flint characters appear to be largely—I do not say entirely—determined by the plant character possessed by the female parent.

To determine whether Black Mexican sweet corn carries the "flint" character even though it has no "starch" character, it was crossed on a white dent variety. Both types were pedigree corns; that is, they had been grown in isolated plots for at least five years, consequently they may be considered to have been pure. To remove all doubt on this point, however, kernels from the same ears that produced the plants that were crossed were inbred. The inbred ears all proved to be true to their respective characters.

The F_1 generation of this cross, although it showed the regular Mendelian ratio of starchy and non-starchy kernels, consisted both of dent and of flint ears. Neither the flint character nor the dent character was dominant, hence the appearance of the two types. We are forced to the conclusion that the flint character was brought into the combination by the sweet corn parent, and became manifest when it met the "starch" character of the dent corn parent. In like manner Stowell's Evergreen was shown to carry the "dent" character, by crossing with an eight-rowed starchy flint variety. The F_1 generation contained several dent ears which could only have been produced by the "starch" character of the flint variety meeting the "dent" character of the sweet variety.

It is evident that the internal structure of the corn kernel is based upon several unit characters. There are different patterns of corneous starch which produce pop, flint, dent and starchy varieties. These units seem to be partly independent and partly dependent on starchiness and on shapes of pericarp.

It may also be noted that evidence is accumulating that the above facts regarding sweet corn are largely accountable for the marked superiority in sweetness of most small sweet corn varieties. The "dent" sweet va-

rieties require a longer time between pollination and the date they reach table condition than do the "flint" sweet varieties; and during this time the former kinds appear to change more of their carbohydrate compounds to starch.

E. M. EAST

CONNECTICUT AGRICULTURAL
EXPERIMENT STATION

**THE AMERICAN ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE
SECTION B—PHYSICS**

THE annual meeting of the American Association for the Advancement of Science, Section B, was held in the Physical Laboratory of the Johns Hopkins University, at Baltimore, December 28–31, 1908. This was a joint meeting with the American Physical Society. Each organization held a short session for the transaction of routine business, but the eight sessions for the reading of papers were joint meetings of the two societies.

The presiding officers were Professor Karl E. Guthe, vice-president and chairman of Section B, and Professor Edward L. Nichols, president of the American Physical Society. Professor F. E. Nipher was elected a member of the council, Professor G. F. Hull, of the sectional committee, and Dr. L. A. Bauer, a member of the general committee.

The officers for the next annual meeting, to be held in Boston during the convocation week of 1909–10 are as follows:

Vice-president and Chairman of Section B—Dr. L. A. Bauer.

Retiring Vice-president—Karl E. Guthe.

Members of the Sectional Committee—K. E. Guthe, L. A. Bauer, A. D. Cole, E. L. Nichols, A. Trowbridge, E. B. Rosa, A. P. Carman, G. F. Hull.

In the afternoon of Tuesday, December 29, Professor Dayton C. Miller delivered an address, as retiring chairman of Section B, on "The Influence of the Material of Wind Instruments on the Tone Quality." This has been published in full in SCIENCE, January 29, 1909. It was heard with great interest by a fine audience of about one hundred and fifty. The other seven sessions were attended by from forty to one hundred persons, with an average attendance of about seventy. That on Wednesday forenoon was devoted to subjects of somewhat general interest

and papers by Hayford, More and Bauer of the following program were given at that time.

The hotel headquarters for physicists proved a useful and enjoyable feature of the meetings. Hotel Kernan proved a pleasant gathering place and a large proportion of the visiting physicists were registered here. The most successful social event was the subscription dinner for Section B and the Physical Society, held on Tuesday evening at the Country Club. This was attended by about ninety and was generally declared to be the most successful social gathering of American physicists ever held. The success of the occasion was principally due to the care and zeal of Professor J. S. Ames, of Johns Hopkins University.

The titles and abstracts of the fifty-two papers presented at the several joint sessions are given below.

Fatigue of Metals Excited by Röntgen Rays:

LOUIS T. MORE and R. E. C. GOWDY, University of Cincinnati.

The work is a continuation of the results previously obtained in the same subject and reported at the Chicago meeting of the American Association for the Advancement of Science (see also *Phil. Mag.*, 1907). A new method has been devised for measuring the secondary radiation given off by metals bombarded by X-rays. Previous results have been confirmed and extended.

To account for the secondary radiation, Professor J. J. Thomson has advanced the theory that the X-rays cause a disintegration of the metal and permit the expulsion of charged corpuscles. Our experiments make this theory doubtful. Iron, lead and copper plates with pure surfaces were used and then the plates were coated with thin films of the lower oxides of the metal and again with films of the higher oxides. The effect of this successive oxidation on the fatigue seems to show that chemical changes of the surface produced by the X-rays with the consequent changes of surface-electrified double layers, will account for the phenomena observed.

Errors in Magnetic Testing of Ring Specimens:

M. G. LLOYD, Bureau of Standards, Washington.

This paper is mainly theoretical in character. Formulas are derived connecting the mean magnetizing force with the magnetizing force at the mean radius, and the actual hysteresis loss with the loss which would occur with uniform distribution of flux. Tables and curves illustrate the errors involved and serve to give the necessary corrections in particular cases.

Some Data regarding Recent Magnetic Storms:
L. A. BAUER, Carnegie Institution, Washington.

Renewed interest was recently shown in magnetic storms on account of severe ones last August and September and because of Hale's discovery of the Zeeman magnetic effect in sun-spots. Some concluded that a true explanation of the origin of terrestrial magnetic storms had been found. However, a simple calculation shows that the magnetic field intensity observed in sun-spots is totally inadequate to affect the most sensitive magnetic instruments. Whereas the effects actually observed during storms exceed many times—in fact a hundred fold and more—the limit of measurement (about 1/100,000 C.G.S unit). Little progress has been made in the solution of the problems presented by magnetic storms, one reason being that the investigations to be thorough are beyond the power of the average individual. They must, hence, generally be restricted either to one particular phase or to one element—usually the change in the compass direction. An important question is that of the seat of the forces regarded as causing the observed effects; whether it be above the earth's surface or below, or even of combined origin. Another fundamental question is, whether an actual change of magnetization in addition to a shift of the magnetic axis takes place, and if so its magnitude and duration. In the case of the very notable storm of October 31–November 1, 1903, it would appear as though an actual diminution of the earth's magnetic moment occurred which continued almost for two months after the apparent cessation of the storm. Similar calculations are in progress regarding the more recent storms.

Optical Properties of Electrolytic Films of Iron, Nickel and Cobalt: C. A. SKINNER and A. Q. TOOL, University of Nebraska.

An Absolute Gauge for Measuring High Hydrostatic Pressures: P. W. BRIDGMAN, Harvard University.

The pressure range over which it has been hitherto possible to measure various physical effects of high pressure has been restricted by the fact that the common forms of pressure gauge leak at very high pressures. The best known work in this field has been that of Amagat, who worked to about 3,000 kgm. per sq. cm. This is the working pressure in modern high power artillery. The essential parts of all gauges for these high pressures are a piston fitting a

cylinder so accurately that the friction between them is small and at the same time the leak past the piston is very slow. At high values of pressure the leak becomes so rapid that it is impossible to make measurements. In this paper a form of the usual gauge was described in which the cylinder is made to shrink automatically by the pressure, so that the leak remains slight even at very high pressures, while the freedom of motion of the piston is not impaired. With this gauge pressure measurements accurate to .1 per cent. have been made to nearly 7,000 kgm. per sq. cm. At higher pressures other parts of the apparatus break. This is not the limit of the gauge.

The Resistance of Mercury as a Secondary Gauge for High Pressures: P. W. BRIDGMAN, Harvard University.

In practical use the above form of gauge is inconvenient because it is slow and unwieldy. In this second paper measurements of the electrical resistance of mercury under pressure are given from which the pressure may be calculated if the change of resistance is known. Electrical resistance is very easy to measure, and it is proposed that in practise pressure be measured in this indirect way. The accuracy attainable is .1 per cent. The total change of resistance for 7,000 kgm. is about 20 per cent. As one would expect, the change in the resistance effected by pressure is less when pressure is high, as is also the change brought about by temperature change. The change of resistance is about ten times the change of volume produced by a corresponding pressure.

Methods for Measuring Compressibilities at High Pressures: P. W. BRIDGMAN, Harvard University.

In this paper methods were described for measuring the cubic compressibility of solids or of liquids at these high pressures. Measurements were made of several samples of steel, glass and aluminum. The values for steel fall between the two best previous determinations, which differ by 100 per cent. The other values agree with the commonly accepted results. The accuracy of the method is about .35 per cent., considerably higher than the best previous determinations. The only liquid measured was mercury. In only one instance has this been measured before to more than 500 kgm., when measurement was made to 3,000 kgm. The value found in this work agrees with former values, except that the change of

compressibility with pressure seems somewhat less than has been supposed.

An Experimental Determination of the Terminal Velocity of Fall of Small Spheres in Air: JOHN ZELENY and L. W. MCKEEHAN, University of Minnesota.

Stokes's formula for terminal velocity of fall of a sphere in a viscous fluid expresses the result in terms of the acceleration of gravity, the radius of the sphere, the density of the sphere, the density of the fluid and its viscosity. This formula has been used by J. J. Thomson, H. A. Wilson and others in the determination of the charge carried by a gaseous ion.

The velocity of fall of lycopodium, which satisfies Stokes's criterion that the sphere shall be small, was determined experimentally. Variations in the size and density of individual particles were provided against by finding the time of fall, in a wide tube, of a large number of particles in each experiment. The time of fall of the center of gravity of the cloud of particles was assumed to be that of a single particle of average radius and density. The uniformity of the material makes this admissible.

The formula gives velocities, for this particular size, 50 per cent. in excess of those observed. Since this difference depends probably on the size employed, the amount by which the charge on an ion must be increased can not be stated until further experiments are carried out with particles of different sizes.

Note on the Effect of the Phase of Harmonics on Sound Waves: M. G. LLOYD and P. G. AGNEW, Bureau of Standards, Washington.

A harmonic alternator set giving frequencies from 60 to 900 was used to excite a telephone. By choosing a fundamental from one machine and a harmonic from another, and then driving the two generators just out of synchronism, a continuous cyclic change of phase relation occurs. Ordinarily the combined tone sounded by the telephone changes periodically, but these changes are really beats due to the interference of higher harmonics common to the two sources. By connecting the generators three phase, star, and choosing frequencies having a ratio of 3 to 1 or 9 to 1, common impurities are eliminated. When so connected no change in the sound could be detected at low intensities. With louder tones there were cyclic changes which were believed to be due to harmonics introduced by the telephone itself, rather than to an actual dependence of quality upon phase.

Magnetic Double Refraction Normal to the Field in Liquids: C. A. SKINNER, University of Nebraska.

Fourteen different liquids were investigated, including nitrobenzol, nitrotoluol, chlor-benzol, brom-benzol, etc. Twelve of them showed electric double refraction. Each was studied through the spectrum from blue to red (440 to 660). The two effects agree in the law of variation. In carbon bisulphide alone were the electric and the magnetic β of opposite sign.

The Absorption Spectra of Various Potassium and Uranyl Salts: HARRY C. JONES and W. W. STRONG, Johns Hopkins University.

The purpose of this investigation was to find out the nature of the absorbers of the light rays and the effects upon them of external conditions. It is possible in the case of the uranium atom or molecule to make a large number of changes that affect its absorbing power. Salts like the nitrate, sulphate, bromide, acetate and chloride of UO_2 have been used. This gives the effect of the chemical radical on the absorption. Different solvents can be used and various concentrations and the temperature varied. The solution can be placed under great pressure or in a powerful magnetic field. Dehydrating agents like aluminium chloride and sulphuric acid can be added. Some or all of these changes are being made and some interesting results have been found.

A Rowland concave grating is used to give the absorption spectra. Wratten and Wainwright red sensitive films are used for the photographic work. The work is being carried on by a grant from the Carnegie Institution of Washington and is a continuation of the work of Jones and Anderson (Publication No. 110, Carnegie Institution).

Beer's law was found to hold for potassium chromate, potassium dichromate, potassium ferrocyanide and potassium ferricyanide. Concentrated solutions of the uranyl salts do not obey Beer's law.

Uranyl salts show ten absorption bands in the blue-green part of the spectrum. When aluminium chloride is added to uranyl chloride these bands are shifted towards the red. Calcium chloride acts in the same way. Several new bands have been found for the chloride (these are very narrow) which none of the other uranyl salts have so far been found to show.

New Series in the Spectra of Ca, Sr and Ba: F. A. SAUNDERS, Syracuse University.

Photographs of the arc and spark spectra of Ca, Sr and Ba, taken with a quartz spectrograph, show several new ultra-violet lines. In Ca a new spectrum series was found, consisting of reversed single lines, beginning with $\lambda 2398$, eight lines in all being observed, five of them new. In Sr a similar series exists, seven lines having been observed. In Ba there are evidences of the same sort of thing. Series of pairs have been known for some time to exist in these spectra; few of the lines, however, having been picked up. Four new pairs were found in Ba and two in Sr, which help to fill out the two "subordinate" pair series in each of these elements. Formulae which represent these series were calculated out, as was also done in the case of the series first mentioned.

Ionization in Closed Vessels: W. W. STRONG,
Johns Hopkins University.

The purpose of these experiments is to find what the nature of the external radiations are, that produce part of the ionization in closed vessels. In order to do this it is necessary to use a vessel in which the ionization produced by the walls of the vessel itself is constant. This ionization can be easily found by putting the vessel within a thick screen of metal or water so that all external radiations are absorbed.

Electroscopes were used for this work and the ionization of the enclosed gas was measured by means of the rate of leak of the electricity from the gold-leaves suspended inside the electroscope. The charged system inside the electroscope could be charged from the outside by means of a small spark gap. The electroscope was, therefore, air-tight and everything inside the vessel remained the same unless affected by radiations that could pass through the walls of the electroscope.

By letting the electroscope into a large cistern it was surrounded by a screen of water at least four feet thick. This was done with an electroscope September, 1907 (*Phys. Rev.*, p. 44, July, 1908). The same electroscope was placed in the same cistern, July, 1908. (Readings of the electroscope were here given.)

These readings show that the natural ionization within the vessel had remained practically constant throughout almost a year.

The same electroscope (and others in a like manner) when placed outside of buildings showed very marked increase in its rate of leak during the day. This, therefore, must be due to some external radiation that was screened off by the water in the cistern. (Screens of lead and iron

were also used.) Care was taken to keep the temperature of the electroscope constant.

Velocity of the Negative Ions Produced by the Ultra-violet Rays in Various Gases at Different Pressures and Temperatures: ALOIS F. KOVÁŘÍK, University of Minnesota.

The object of this investigation is the study of the structure of the negative ion. For this purpose the velocity is measured at different pressures and at different temperatures. The method used is that of an alternating field. In the case of air the product of the velocity by the pressure is nearly constant between the pressures 760 mm. and 200 mm., but at 100 mm. this product increases by 25 per cent., at 60 mm. by 65 per cent. and at 4.3 mm. by 200 per cent. above the value at 760 mm. In the case of CO₂ the product changes a little more rapidly. The velocity of the negative ions in dry air at 760 mm. and 0° C. is 2.05 cm. per second for a gradient of 1 volt per centimeter, and in dry CO₂ at ordinary conditions of pressure and temperature, the velocity is about 1.02 cm. per sec.

Preliminary experiments with change of temperature were made in air and up to 400° C. the velocity was found to vary inversely as the density of air. These experiments are being continued.

Momentum Effects in Electrical Discharge: F. E. NIPHER, Washington University.

An electrical discharge is sent around a right angle in a wire. Spark discharge passes from machine to earth in either the positive or negative line.

A very marked difference between the positive and the negative discharge is found. A decided difference between the effects on the photographic plate is found on the two sides of the angle. The negative discharge is the active one in both lines. An account of these experimental results is given in SCIENCE for December 4, 1908. The actual effects were shown by means of a large number of lantern slides.

Electrical Stimulation of Plant Growth: AMON B. PLOWMAN, Beaver, Pa.

Experiments and observations extending through a period of more than ten years, indicate rather conclusively that electrical charges of positive sign more or less completely inhibit the vital processes of plant protoplasm through which such charges are caused to pass; while, within a rather wide range of conditions, negative electrical charges stimulate such processes, sometimes to a quite remarkable degree.

Most of the striking results of electro-culture, including those recently obtained by Sir Oliver Lodge, are quite readily accounted for, if the above conclusions are correct.

This paper was illustrated by means of several photomicrographic and other lantern slides.

Note on the Kathode Equilibrium of the Weston Cell: F. A. WOLFF, Bureau of Standards, Washington.

The Theory of Coupled Circuits: LOUIS COHEN, Bureau of Standards, Washington.

It is a well known phenomenon that when two electrical circuits are coupled together either electromagnetically or direct, two distinct oscillations will be produced in either circuit, and there will also be two distinct damping factors. The problem was the subject of several important papers by several eminent German physicists, but there are certain mathematical difficulties inherent in the problem, which made it difficult to get the complete solution, and all previous investigators limited themselves to some form of approximation.

In this paper an entirely different method of mathematical treatment was adopted and which made it possible to obtain an exact solution. The paper being of a mathematical nature it is rather difficult to give an outline of the work in an abstract. The results are as follows: If we denote by V_1 and V_2 the potentials in the primary and secondary circuits, we have

$$V_1 = \{H_1 e^{-a_1 t} + H_3 e^{-a_2 t}\} \cos \lambda_1 t + \{H_2 e^{-a_1 t} + H_4 e^{-a_2 t}\} \cos \lambda_2 t,$$

$$V_2 = H_5 \{e^{-a_1 t} + e^{-a_2 t}\} \cos \lambda_1 t + H_6 \{e^{-a_1 t} + e^{-a_2 t}\} \cos \lambda_2 t,$$

a_1 and a_2 are the damping factors, λ_1 and λ_2 are the frequency constants and they have been completely determined.

Photographic Registration of Sounds: DAYTON C. MILLER, Case School of Applied Science, Cleveland.

For making large scale records, showing the details accurately, of complex sound waves having frequencies ranging from 500 to 10,000, the phonograph and oscillograph methods seem unsuitable. The following direct mechanical method has given satisfactory results.

A small steel cylinder, 1 mm. in diameter, is arranged to receive angular motion with a minimum of reaction effects, which is proportional to the displacement of a sensitive diaphragm. A minute mirror, with its plane in the axis of the

cylinder, reflects light to a special camera, and at a distance of 30 cm. gives waves 15 cm. wide which show great detail. Long strips of photographic films were shown and projected by the lantern, showing with great clearness and in full detail the record of overtones, intensity variation, etc., of various spoken phrases. (The words "physical laboratory" received careful and interested attention from the audience.)

The Thermodynamics of Saturated Vapors: J. E. SIEBEL, Chicago, Ill. (Read by title.)

The object of this paper is to demonstrate the necessity of an investigation as to whether certain hypothetical concepts in the theories of thermodynamics and which find their most general expression in the assumption of a universal identical zero of energy (-273° Cels.) and a supposed universally irretrievable dissipation of energy are equally applicable to the thermodynamics of saturated vapors as they appear to be to the thermodynamics of permanent gases.

The Heat Balance in Thermoelectric Batteries: J. E. SIEBEL, Chicago, Ill. (Read by title.)

The author attempts to show that the heat and electricity exchanged in thermoelectric elements are functions of temperature, specific heat and conductivity and produces a formula and calculations made thereby, the results of which latter conform apparently well with a number of experimental results obtained by other observers.

The Effect of the Magnetic Impurities in the Copper Coils of Moving Coil Galvanometers upon their Sensitiveness, Hysteresis and Zero Shift: ANTHONY ZELENY, University of Minnesota.

The magnitude of the effect due to the magnetic impurities in the copper coils upon the sensitiveness of a moving coil galvanometer was determined by obtaining the period of vibration of the coil system in and out of a magnetic field.

If M represents the moment, per unit angle of displacement of the coil, due to the magnetic impurities; T , the torsional moment; and t_1 and t , the periods of vibration of the system when the coil is within and outside of the magnetic field; then

$$M/T = (t^2 - t_1^2)/t_1^2.$$

The value of the galvanometer constant is increased due to the magnetic impurities by the factor $(1 + M/T)$.

The values of M/T were determined for several galvanometer coils in fields of various strengths produced by an electromagnet. The values, when using a 1.5 mil phosphor-bronze strip for the upper suspension, varied for different coils from

0.82 to 1.31, in a field whose intensity was 400 units, which is the intensity usually found in ordinary galvanometer fields.

By plotting the relation between M/T and the field strength when the values of the latter were both increasing and decreasing, a marked hysteresis was found, which explain the hysteresis observed in galvanometer deflections whose magnitude depends somewhat on the direction from which the coil comes to its deflected position.

The relation between the strength of the magnetic field and the "set in the fiber" obtained after a reversed deflection was found to be proportional to the strength of the field, except that in weak fields there was no observable set. This shows, as previously explained by the writer, that the set is practically all due to a change in the strength and the direction of magnetization of the impurities in the coil. This magnetization gradually returning to its normal strength and direction explains also, in part at least, the shifting of the zero point with time.

The Three Temperature Coefficients of the Moving Coil Galvanometer and their Relation to the Temperature Coefficients of its Various Parts:
ANTHONY ZELENY and O. HOVDA, University of Minnesota.

The values of the temperature coefficients for galvanometers having chilled cast-iron magnets are given in the following table, where B is the temperature coefficient of a particular circuit.

Measurement	Suspension	Coefficient
Current,	Phos. bronze,	+ 0.00018
	Steel,	+ 0.00005
Potential,	Phos. bronze,	+ 0.00018 - B
	Steel,	+ 0.00005 - B
Ballistic,	Phos. bronze,	- 0.00017
	Steel,	- 0.00017

The temperature coefficient for current measurements is shown to be

$$d_k' = F_k + t_k + L_k - D_k, \quad (1)$$

where d_k' , F_k , t_k , L_k , D_k , are the temperature coefficients respectively for deflections, field strength, period of vibration of the coil, and the linear expansion of cast iron and of copper.

The temperature coefficient for potential measurements can be calculated from

$$d_k'' = d_k' - B, \quad (2)$$

where B , as given above, is the temperature coefficient for the resistance of a particular circuit.

The temperature coefficient for ballistic throws is

$$d_k = d_k' - t_k. \quad (3)$$

These equations enable any one of the three temperature coefficients to be calculated from the known temperature coefficients of the various parts of the galvanometer.

The temperature coefficients of a galvanometer with a magnet other than chilled cast iron can be calculated from

$$K' = K + (F_k' + 0.00040), \quad (4)$$

where K represents the value of any particular coefficient given in the above table, corresponding to the one desired, and F_k' is the temperature coefficient of the field strength for the magnet of the galvanometer whose temperature coefficient is to be determined.

A New Method for the Absolute Measurement of Resistance: E. B. ROSA, Bureau of Standards, Washington.

A Plea for Terrestrial and Cosmical Physics: L. A. BAUER, Carnegie Institution, Washington. This paper will be published in full in SCIENCE.

The Ellipticity of the Earth is Not a Proof of a Former Liquid State: JOHN F. HAYFORD, Coast and Geodetic Survey, Washington.

The idea is often expressed, even by physicists of high rank, that the observed ellipticity of the earth is a proof of a former liquid state. This idea is based upon a gross misconception of the magnitude of the stresses which would be produced within the earth by any departure of the actual ellipticity from the value corresponding to the rate of rotation. Sir George Darwin has computed that a departure of only one seventh part, of the actual ellipticity from that corresponding to the rotation, would produce stress-differences in the interior of the earth as great as five tons per square inch. Even the best granite will ordinarily fail under a stress-difference less than five tons per square inch. Therefore, unless the earth in its inner parts is stronger than the best granite it will yield to the stresses and take a new shape before the actual ellipticity has departed from that due to the rotation by as much as one seventh part.

Any one who will start from this as a basis and consider the improbability of the earth being as strong as the best granite throughout, even if it is solid, consider the improbability of the material in the earth being incompressible under stresses applied continuously for ages, and consider the uncertainty introduced into the evaluation of the theoretical ellipticity due to rotation on account of this evaluation being affected by the assumed relation of depth and

density, he will reach the conclusion that the present apparently close agreement between the observed ellipticity and the theoretical ellipticity due to rotation is not a proof of a former liquid state.

He will conclude that it is merely an indication of the strength of the material in the interior of the earth, and that the evidence is far from being sufficient to prove that the strength of the material in the interior, available to resist stress-differences, is now or ever has been so small as to justify the statement that the material is or has been a liquid.

Atomic Theories: L. T. MORE, University of Cincinnati.

*An Electrical Method for Determining the Amount of Moisture in Grain and Other Materials:*¹ ANTHONY ZELENY, University of Minnesota.

Two plates or pointed conductors made of dissimilar metals are inserted into the material in which it is desired to know the amount or percentage of moisture. These plates or points form the electrodes and the moisture the electrolyte of a voltaic battery which causes a current to flow through the galvanometer, whose magnitude depends on the amount of the moisture.

The size of the scale divisions representing any definite amount of moisture is first determined experimentally for each particular kind of material. When the temperature of the material under test influences the magnitude of the deflection, a proper galvanometer shunt is used with its lugs labeled in degrees, so that, when set to indicate the temperature of the material, the proper values for the amount of moisture are obtained regardless of the temperature.

In the case of corn, it was found desirable to have the two dissimilar metals of copper and zinc in the form of points which are pressed into the germ of the individual kernel. The deflection obtained indicates directly the percentage of moisture in the whole kernel. A curve exhibiting the relation between the deflection and the percentage of moisture was shown.

This apparatus is found to be capable of giving values accurate to about 0.1 per cent.

On the Extra Transmission of Electric Waves:

F. C. BLAKE, Ohio State University.

With the same apparatus that Blake and Fountain (*Phys. Rev.*, XXIII., p. 257, 1906) used, the conditions insisted upon by Dr. Schaefer (*Phys. Rev.*, XXIV., p. 421, 1907) were fulfilled. Two

¹ Patent pending.

diaphragms, 2.5 meters square and of aperture 24 by 32 cm., were inserted, one near the vibrator mirror, the other near the receiver mirror with the resonator system between them. Nine per cent. of *extra transmission* was found, using long strips 3 cm. apart on plate glass. Afterward only a single diaphragm was used, it being placed as near as possible to the receiver mirror. Its aperture was 68.5 cm. long and of a width that was varied from 8 to 61 cm. The *extra transmission* was 15 per cent. in amount and independent of the width of the diaphragm aperture.

Taking this last value as a true measure of the extra transmission it would appear that the use of diaphragms, especially when their apertures are as small as Schaefer demands, introduces errors due to diffraction, but in no case does it completely mask the effect of extra transmission.

Then the vibrator was varied by short steps a distance of 1 cm. either way from its usual focal position of 7.5 cm., a single diaphragm of aperture 68.5 by 16 cm. being used near the receiver mirror. No change in the extra transmission was obtained, although these vibrator changes changed the beam from one quite strongly divergent to a convergent beam.

Entladungsstrahlen: ELIZABETH R. LAIRD, Mount Holyoke College.

A Spectrometer for Electromagnetic Radiation: A. D. COLE, Ohio State University.

The continuation of work on diffraction of electric waves, on which a partial report was given at the New York meeting of the American Association for the Advancement of Science, made it desirable to have a more convenient means of quickly changing the angle between the direction of wave propagation and the line connecting the diffraction edge or slit with the receiver. This resulted in a mounting for the several parts of the apparatus similar to that of the parts of a working spectrometer for light radiation.

It seemed worth while to develop the design still farther, so that the apparatus might later be used by advanced students as a more convenient means of repeating the classical experiments of Hertz, Boltzmann and Righi. The use of the conventional spectrometer design serves to strengthen the force of the analogy between electrical and light radiation, particularly when used for lecture demonstrations, for which it is well adapted. Drawings of the apparatus with a considerable variety of accessories for special uses, were shown and described. By a few simple

changes and adjustments it is easily and quickly adapted for use as an optical bench or as an interferometer for electromagnetic radiation. The wave-lengths preferred are from 10 to 15 cm., the parabolic mirrors of 35 cm. aperture, lenses and prism 22 cm. high, prism-table 26 cm. diameter, and the length over all 225 cm. It is made of oak, and provided with four graduated circles for reading the angles through which different parts of the apparatus are rotated when in use.

A Method of Determining the Electrode Potentials of the Alkali Metals: GILBERT N. LEWIS and CHARLES A. KRAUS, Massachusetts Institute of Technology.

The electrode potentials of the metals of the alkalies and the alkaline earths, notwithstanding their great importance, have never been determined, because of the extreme reactivity of these metals. The method now adopted, which has proved entirely successful in the case of the sodium electrode, consists in measuring the electromotive force between the metal and its dilute amalgam in mercury, with an electrolyte consisting of a solution of a salt of the metal in liquid ethyl amine. The electromotive force so obtained can readily be shown to be independent of the electrolyte and the solvent. It is, therefore, the same as would be obtained if the electromotive force between the metal and amalgam could be measured in an aqueous solution. The potential of the amalgam, against a normal aqueous solution of a salt of the metal may with certain precautions be measured directly against a normal electrode. Adding the electromotive force so obtained to the electromotive force between the metal and amalgam gives directly the potential of the metal in a normal solution of its ion in water (potential of the normal electrode taken as zero). In the case of sodium, this method has made it possible to determine the electrode potential within a few tenths of a millivolt. The value obtained is about half a volt higher than that which has been previously assumed for the sodium electrode.

Non-Newtonian Mechanics and the Principle of Relativity: GILBERT N. LEWIS and RICHARD C. TOLMAN, Massachusetts Institute of Technology.

The laws of non-Newtonian mechanics previously derived by one of the authors from the fundamental conservation laws and from a simple assumption in regard to the nature of light are identical with those which Einstein has obtained from the principle of relativity and the laws of

electro-dynamics. In this paper it is shown that the same equations may be obtained without the aid of the electro-magnetic theory from the principle of relativity and the conservation laws.

On the Influence of Temperature and Transverse Magnetization upon the Resistance of Bismuth and Nickel: F. C. BLAKE, Ohio State University.

The resistance of nickel and bismuth was investigated over a range of temperature from -192° C. to $+183^{\circ}$ C., and for all field-strengths between 0 and 36.6 kilogauss. For measuring temperature flat spirals of fine platinum wire were attached to the mica supports of the bismuth and nickel spirals. The apparatus was that previously used by duBois and Wills (*Verh. d. D. Phys. Ges.*, I., p. 169, 1899).

At liquid air temperatures no such high values of the resistance of bismuth were obtained as had been obtained by Dewar and Fleming and by duBois and Wills. Instead, a maximum of resistance was found between -160° and -180° C. for fields greater than 30 kilogauss. The higher the field the higher the temperature at which this maximum appeared.

If R' is the resistance in the field H at the temperature T , and R_0 the resistance without the field at 0° C., then $R'/R_0 = f(T, H)$. A set of isothermal curves, $R'/R_0 = f(H)$ and another set of isopetal curves, $R'/R_0 = f(T)$ were experimentally determined.

For nickel a set of isothermal curves, $(R' - R)/R_0 = f(H)$, where R is the resistance of the nickel out of the field at temperature T . For all temperatures investigated the fraction $(R' - R)/R_0$ was negative for fields greater than 2,500 gauss, and its value was greater for the higher temperatures. For fields greater than 10 kilogauss it increased with increasing field except at liquid air temperatures; at -190° C. it was a maximum at 8 kilogauss, decreasing slowly for higher fields. For fields less than 2,500 gauss this fraction was positive and it was thought that part or all of this increase in resistance for low fields could be explained by longitudinal magnetization, whose presence could not be wholly avoided.

A New Form of Standard Resistance: EDWARD B. ROSA, Bureau of Standards, Washington.

The new form of resistance standard, which has been developed at the Bureau of Standards during the past two years, differs from the Reichsanstalt form in being smaller and having the resistance coil sealed air tight in a case that is filled with pure oil, insuring protection for the resistance

coil from the effects of atmospheric moisture, reduces the danger of oxidation due to imperfect covering of shellac, and protects the coil from mechanical injury. The resistances when properly prepared and mounted and protected in this manner, remain remarkably constant in value, whereas open coils in oil almost invariably have a higher resistance in summer than in winter, and fluctuate more or less in value from time to time with the weather. As a result of the discovery of the effect of atmospheric humidity on the resistance of standards made at the Bureau of Standards, the National Physical Laboratory of England has sealed its standards, and the German Reichsanstalt is keeping its standards in a chamber at a constant humidity. The use of the new sealed resistances at the Bureau of Standards has increased the accuracy of resistance work appreciably.

A Proposed Modification of the Kirchhoff Method for the Absolute Measurement of Resistance:
FRANK WENNER, Bureau of Standards, Washington.

An Instrument Designed for More Precise Determination of Magnetic Declination at Sea:
WILLIAM J. PETERS, Department Terrestrial Magnetism, Washington.

The cruises of the *Galilee* in the Pacific Ocean, among other results, made very apparent the necessity of more accurate determinations of magnetic declination than could be made with the ordinary instruments of navigation. A collimating instrument has been constructed by Mr. A. Widmer, mechanician of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, which will be used in experimental work on the vessels now being built for a magnetic survey of the ocean areas. Experiments were made on the last cruise of the *Galilee* which assured the practicability of using such an instrument and indicated the possibility of a high order of accuracy.

Many parts of the Ritchie ten-inch liquid compass were used. The card was altered to a four direction collimator by the addition of four concave mirrors with a scale of seven divisions in the focus of each. This alteration increased the original mass by one twentieth part, but decreased the radius of gyration. The period of the collimator arrangement in liquid is now about eleven seconds at Washington. The angle between a collimator axis and a celestial body is measured by a pocket sextant, the scale being viewed through windows in the bowl. The instrument is

not intended for a navigation instrument, but as a step in the attainment of the highest precision in determinations of magnetic elements at sea.

(The paper will be printed in full in the March number of *Terrestrial Magnetism and Atmospheric Electricity*.)

The Electrical Conductivity of the Atmosphere Over the Pacific Ocean: PAUL H. DIKE, Carnegie Institution, Washington.

The work described was done on board the Magnetic Survey Yacht *Galilee* during the cruise of 1907-08. The purpose was to obtain data as to the earth-air current at sea, to compare with similar results obtained on land. The method involves the measurement of two quantities, the specific conductivity of the air and the vertical potential gradient. The latter measurement was found to be impracticable on board ship, and only a few values were obtained, during a calm. These were of the same order of magnitude as are ordinarily observed on land. The specific conductivity of the air was measured by means of the Gerdien apparatus, consisting of a cylindrical condenser, the inner cylinder of which is connected with an electroscope. The conductivity of the air is computed from the rate of dispersion of a charge put upon the inner cylinder when a uniform current of air is drawn through the apparatus. The reading of the electroscope offered the principal difficulty.

The mean values of the conductivity from all the observations of the voyage were as follows:

$$\lambda_p = 1.603 \times 10^{-4} \text{ electrostatic units.}$$

$$\lambda_n = 1.433 \times 10^{-4} \quad " \quad "$$

$$\lambda_p/\lambda_n = 1.12$$

Assuming a potential gradient of 100 volts-meter these values of conductivity give a vertical earth-air current 3×10^{-18} amperes per square centimeter of the earth's surface, slightly larger than the usual value on land. No variation with latitude was discernible, though the observations extended from $65^{\circ} 41'$ north to $45^{\circ} 07'$ south.

Ultra-violet Absorption and Fluorescence and the Complete Balmer Series of Sodium Vapor: R. W. Wood, Johns Hopkins University.

The absorption spectrum of dense sodium vapor, contained in a steel tube one meter in length, provided with quartz windows and heated red hot in a combustion furnace, shows the lines of the principal series (Balmer formula) reversed. But seven lines of this series have been previously observed, the observations having been confined to the emission spectrum.

Employing a small quartz spectrograph by Fuess (focus 15 cm.) 24 lines were found and measured and indications of the "head" of the series appeared in the plate though it was not resolved into lines.

With the large quartz spectrograph of the Bureau of Standards 48 lines were resolved, bringing us within 0.1 of an Angstrom unit of the theoretical head of the band. The largest number of lines forming a Balmer series ever observed in the laboratory is twelve in the case of hydrogen (Cornu and Ames). Solar hydrogen (chromosphere) shows 29 lines. The sodium series is 19 ahead of any Balmer series ever observed, even in celestial sources. These ultra-violet lines are accompanied on each side by a channelled spectrum, analogous to the channelled spectra observed in the vicinity of the *D* lines, which form the first member of the Balmer series.

It is in the region of the channelled spectra that the interesting results in the fluorescence of the vapor previously described were found. An attempt was accordingly made to ascertain if the ultra-violet channelled spectra exhibited the same phenomena. Such was found to be the case. Exciting the vapor with the zinc spark, a strong fluorescence was found to be stimulated by the zinc triplet at 3344-3302.

Results of Some Recent Intercomparisons of Magnetic Standards by the Carnegie Institution of Washington: J. A. FLEMING, Carnegie Institution, Washington.

One important detail of the magnetic survey of the globe undertaken by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington is that of the correlation of the observatory standards of various governments and institutions. Comparisons have already been made at seventeen observatories in various parts of the world; the results of the four most recent intercomparisons were discussed in detail in the paper and may be summarized thus: The following corrections should be applied to the provisional standards of the Department of Terrestrial Magnetism of the Carnegie Institution. The probable errors of mean differences are given with them. For Kew Observatory; declination $+0'6 \pm 0'15$, horizontal intensity $-0.0001H \pm .00005H$, inclination $-2'6 \pm 0'1$. For Helwan; dec. $+0'5 \pm 0'1$, hor. intens. $+0.0004H \pm .00004H$, inclin. $+0'1 \pm 0'1$. For Tiflis; dec. $+0'7$, hor. inten. $+0.0006H \pm 0.00006H$, inclin. $-1'7 \pm 0'1$. For Christchurch; dec. $+1'5$

± 0.04 , hor. inten. $+0.0006H \pm .00006H$, inclin. $-1'2 \pm 0.3$.

The values are to be applied algebraically, east declinations, north inclinations and horizontal intensities being considered positive, and west declinations and south inclinations, negative. The preliminary "International Magnetic Standard" for horizontal intensity is confirmed in view of the accordance of the correction at Kew with the indications of Watson's determinations of the earth's field in international units.

A Critical Review of the Problem of Pressure in the Kinetic Theory of Gases: LUIGI D'AURIA, Philadelphia, Pa.

This paper seeks to show that the recognized method of solution of this problem is erroneous and the gaseous pressure per unit area is equal to the energy of agitation of the gas per unit volume. It will be printed in *Popular Astronomy*.

The Dynamophone: J. BURKETT WEBB, Stevens Institute of Technology.

Some years ago the problem arose of measuring the power which a turbine transmitted through its shaft to the propeller. The ordinary "indicator" being useless, a method depending on the torsion of the shaft was invented. As it was the intention to protect it by patent, it could not be published sooner, but it has leaked out somewhat and more or less incorrect references to it have appeared in German papers.

The first idea was to measure the torque optically, but a better method was adopted. The apparatus necessitates no mechanical contact with the shaft and the speed can also be observed without the usual speed counter. The degree of accuracy is very high, there being no difficulty in making single observations within one per cent. of error.

The apparatus consists of two toothed iron rings which are fixed permanently to the flanges of the shaft at as great a distance apart as possible. Opposite these rings on a frame fast to the floor are mounted telephone magnets adjustable radially and concentrically as to the shaft axis. Each ring and magnet (or pair of magnets) constitutes an alternating dynamo whose current intensity can be regulated by the radial adjustment of its magnet and whose phase can be varied by the concentric movement, and these two dynamos are connected in series so that when the shaft is not twisted their phases are opposite and neutralize each other in a receiver inserted in the circuit. When, however, the shaft twists the phases become different and a clear tone is perceived.

To measure the torque one of the concentric adjustments is then made until the tone disappears and the angular change read on a scale graduated preferably to horsepower per revolution. The pitch of the tone compared with a calibrated tuning fork gives the speed. The necessary calibration of the shaft is made before it is placed in position or it can be made afterward. (A model was shown.)

Some Optical Effects of Changes in Ether Density:
CHARLES F. BRUSH, Cleveland, Ohio. (Read by title.)

The Lumeter, a Practical Measure of General Luminosity: HENRY E. WETHERILL, M.D., Philadelphia. (Read by title.)

A Ballistic Dynamometer Method of Measuring Hysteresis Loss in Iron: MARTIN E. RICE and BURTON McCOLLUM, University of Kansas. (Read by title.)

The sample to be tested, which should be laminated, is wound with a primary coil and a test coil. The latter is connected in series with the fine wire movable coil of a dynamometer and the former in a series with the coarse wire-fixed coil of the dynamometer. When the primary current is reversed, the dynamometer measures by its ballistic deflection the total energy loss per half cycle in the iron and in the test coil circuit. Since the hysteresis loss is independent of the period of the cycle while all the other losses measured are inversely proportional to the period of the cycle, it is easily possible by the insertion of a choke coil in the primary circuit and the use of a moderately high resistance test coil circuit to keep these other losses below one per cent. of the total loss measured. A comparatively rough estimate of these other losses is then sufficient to enable the true hysteresis loss to be determined with an error of only a small fraction of one per cent.

The dynamometer can be calibrated by discharging a condenser or a mutual inductance through its movable coil while a constant current is maintained in its fixed coil.

This method eliminates the difficulties inherent in the wattmeter methods due to uncertainties in frequency and wave shape while it avoids the tedious process of taking a long series of readings, plotting a curve and measuring its area, as in the ballistic galvanometer methods. Tests can be made much more rapidly than by the wattmeter methods, while the results obtained are fully as accurate as by the ballistic galvanometer methods.

On the Diurnal Variations in the Intensity of the Penetrating Radiation Present at the Surface of the Earth: G. A. CLINE, Toronto University.

On the Character of the Radiation from Potassium: J. C. MCLENNAN, Toronto University.

The Action of Electrolytes on Copper Colloidal Solution: E. F. BURTON, Toronto University.

The experiments detailed in the present communication are a continuation of those performed by the writer on the action of small traces of electrolytes on silver and gold colloidal solutions prepared by Bredig's method. With these solutions the particles in the pure solution are negatively charged and it was found that, if an electrolyte was added, the positively charged ion was the potent one in reducing the velocity with which the particle moved in a given electric field; i. e., the ion charged oppositely to the colloidal particle produces the discharge of the particle and consequently coagulation of the colloid.

Copper colloidal solutions were chosen on which to work because they have positively charged particles in the pure solution. The electrolytes used were solutions of potassium chloride, potassium sulphate, aluminium sulphate, potassium phosphate, potassium ferricyanide. With this series it was possible to compare the effect of the monovalent and the trivalent ions of both acids and bases.

Every electrolyte added produced a decrease of the velocity with which the copper particles moved to the cathode. It is the ion bearing the negative charge which is active in reducing the velocity. This power of the negative ion depends on the valency in a way analogous to the relations found by Pierton and Linder, and Hardy for the coagulative power of ions. Evidence is also produced to show that the discharging power of two negative ions of the same valency is the same. Current observations on the coagulation of the colloids in each case showed that the particles coagulate more and more freely as the charge gets smaller and smaller.

Arc and Spark Phenomena in the Secondary of a High Potential Transformer: E. S. JOHONNOTT, Rose Polytechnic Institute. (Read by title.)

The Upper Inversion in the Atmosphere: W. J. HUMPHREYS, Mt. Weather Observatory, Md.

We have been accustomed to think of the atmosphere as growing steadily colder to nearly or quite absolute zero with increase in elevation, but hundreds of records obtained in many parts of the world by the aid of free balloons show that this assumption is very wide of the truth.

These records tell us, among other things:

(a) That through the first ten thousand feet next the earth the temperature changes irregularly, and often has one or more layers warmer than the regions immediately below or above them.

(b) That roughly between ten thousand and forty thousand feet above the surface of the earth the temperature falls tolerably regularly, approximately at the rate of $0^{\circ}.7$ C. per hundred meters, or $0^{\circ}.4$ F. per hundred feet.

(c) That somewhere in the neighborhood of forty thousand feet elevation the temperature quits falling, usually abruptly, and commonly increases slowly from this level up to the greatest elevation yet reached, about 26.6 kilometers ($16\frac{1}{2}$ miles).

The place where the temperature quits falling and begins to rise is called the inversion level. Its elevation and its temperature both change with seasons, with latitude, and with storm conditions.

This inversion and all the other phenomena connected with the temperature gradients of the atmosphere appear to be satisfactorily accounted for by the known composition of the atmosphere and the laws of radiation and absorption.

The paper in full appears in the *Astrophysical Journal*, January, 1909.

Some Results in Solar Magnetism: W. J. HUMPHREYS, Mt. Weather Observatory, Md.

The splendid work of Hale and others at Mount Wilson has led to the conclusions: (a) that sun spots are cooler than the surrounding regions; (b) that they are centers of violent cyclones; (c) that they are accompanied by magnetic fields of great intensity.

Assuming the effective temperature of the sun to be $6,000^{\circ}$ C., simple convection can reduce the temperature of solar vapor to about $5,000^{\circ}$ C., so that lower temperatures, if such exist, must be due to some such explosive action as Fox has shown to accompany the spots.

The observed tangential velocity of 100 kilometers per second can not be accounted for as the result of simple differences in barometric gradients.

The observed magnetic field can not be due to a whirling surface charge, since a charge sufficient to produce it would cause disruptive radial forces. A volume charge, however, of the negative sign, analogous to that which somehow exists in the earth's atmosphere might lead to the observed effects.

The magnetic fields of the sun spots, however produced, can not extend in measurable amounts to the earth, and therefore our magnetic storms are still without a definitely assignable cause.

The full paper appears in *Terrestrial Magnetism and Atmospheric Electricity*, December, 1908.

Note on Thermoluminescence: ELIZABETH R. LAIRD, Mt. Holyoke College.

Theory suggests that the change producing luminescence goes on very slowly at ordinary temperatures in thermoluminescent salts and is merely accelerated by raising the temperature. An additive method of obtaining the effect of thermoluminescence should therefore show its existence at room temperatures.

This was tested by wrapping up photographic plates for different periods of time with sensitive film toward a thermoluminescent salt and developing later, at the same time heating the salt to observe the remaining effect.

The salts used were solid salt solution of calcium sulphate and magnesium sulphate, the same with an undetermined admixture and calcium sulphide which had been kept in the dark some time after all visible luminescence had ceased.

The results showed that the photographic plate was unaffected in each case, with exposures varying from two weeks to two months, according to the salt used and the amount of its previous exposure to light. Where the effect was uneven the greater effect corresponded to the portions showing brighter thermoluminescence. Control plates used with salt that had not been exposed to light after heating showed no effect in the same time.

These experiments indicate that there is a slow change in thermoluminescent salts, probably similar to that occurring at a higher temperature.

ALFRED D. COLE,
Secretary

THE AMERICAN PHYSIOLOGICAL SOCIETY

THE American Physiological Society met in the physiological laboratory of the Johns Hopkins University, December 28 to 31. Sessions for the reading of papers were held in the forenoons of December 29, 30, 31 and the afternoon of December 31. Demonstrations were given in the afternoon. Seventy papers and demonstrations were presented.

A joint session with the American Society of Biological Chemists was held December 29. On the afternoon of the twenty-ninth the society met with Section K to hear the address of the retiring

vice-president (Dr. L. Hektoen) and for a symposium upon the subject of "The Regulation of Physical Instruction in Schools and Colleges from the Standpoint of Hygiene." On the afternoon of the thirtieth there was a combined meeting with Section K, the Society of American Bacteriologists and the American Society of Biochemists. The following general papers were read and discussed:

"Anaphylaxis," by M. J. Rosenau.

"The Physiological Significance of Creatin and Creatinin," by L. B. Mendel.

"The Cause and Diagnostic Value of the Venous Pulse," by A. W. Hewlett.

The meeting was the largest in the history of the society, more than 80 members being present.

The following were elected to membership: T. G. Brodie, of Toronto; W. W. Hale, of Washington; W. A. Hewlett, of Ann Arbor; A. D. Hirschfelder, of Baltimore; A. Hunter, of Ithaca, N. Y.; D. R. Joseph, of New York; W. J. Meek, of Madison, Wis.; F. R. Miller, of Toronto; F. H. Scott, of Minneapolis; S. Simpson, of Ithaca; C. Voegtlind, of Baltimore.

The following officers were elected:

President—W. H. Howell.

Secretary—R. Hunt.

Treasurer—W. B. Cannon.

Additional Members of Council—A. J. Carlsen, W. P. Lombard.

REID HUNT,
Secretary

THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

THE twenty-first annual meeting of the American Association of Economic Entomologists was held at the Eastern Female High School, Baltimore, Md., December 28 and 29, 1908. The annual address of the president was presented by Dr. S. A. Forbes, on "Aspects of Progress in Economic Entomology." A full program of interesting papers was presented at each session. A general discussion of the subject "Do we Need the Insectary?" was participated in by many of the members and many important facts were brought out in connection with the use of this important accessory to entomological work.

The report of the secretary showed that the association was making a healthy growth and that it was in a good financial condition.

A considerable amount of important business was transacted at the meeting which included a revision of the constitution, the adoption of a resolution defining the attitude of the association

concerning the proposed affiliation of societies interested in agricultural science and the adoption of memorial resolutions on the deaths of Dr. William H. Ashmead, Alexander Craw, Dr. James Fletcher, Professor W. G. Johnson and Professor F. H. Snow, members who had died during the past year.

A long list of uniform common names of insects were adopted on recommendation of the committee on nomenclature.

Thirty-nine new members were elected.

The following officers were elected:

President—Dr. W. E. Britton, New Haven, Conn.

First Vice-president—Dr. E. D. Ball, Logan, Utah.

Second Vice-president—Professor H. E. Summers, Ames, Iowa.

Secretary—Mr. A. F. Burgess, Washington, D. C.

Member of the Committee on Nomenclature—Professor Herbert Osborn, Columbus, Ohio.

Members of the Advisory Board of the Journal of Economic Entomology—Professor Wilmon Newell, Baton Rouge, La., Dr. H. T. Fernald, Amherst, Mass., and Professor Herbert Osborn, Columbus, Ohio.

Members of the Council of the American Association for the Advancement of Science—Dr. S. A. Forbes, Urbana, Ill., and Professor H. E. Summers, Ames, Iowa.

The attendance was the largest of any meeting in the history of the association, over a hundred being present at every session.

A. F. BURGESS,
Secretary

SOCIETIES AND ACADEMIES

THE NEW YORK ACADEMY OF SCIENCES

SECTION OF BIOLOGY

THE regular meeting of the section held at the American Museum on January 11, 1909, was devoted to an illustrated lecture by Professor E. B. Poulton, of Oxford University, on "Mimicry among North American Butterflies." The lecturer was introduced by Mr. Charles F. Cox, president of the New York Academy, who made some brief remarks on selection and mimicry.

Prior to the scientific program a letter was read from Mr. W. K. Gregory, regretfully declining the election to the secretaryship of the section for 1909. Dr. L. Hussakoff was then nominated and elected to the office for the same term.

A REGULAR meeting of the section was held at the American Museum, on February 8, 1909, Mr. Frank M. Chapman, chairman of the section, presiding. The following papers were read:

A New Example of Determinate Evolution: Professor BASHFORD DEAN.

In a previous paper the speaker had shown that the egg-capsule of the chimaeroids at the time of deposition is adapted with singular precision to the needs of the future embryo, and had given reasons for the view that this adaptation was orthogenetic rather than selectional, in a legitimate sense. It was now shown that the egg-capsules of various chimaeroids could be arranged in an orthogenetic series. In this series the head-and-body portion of the capsule becomes progressively shorter, the tail portion more slender, the lateral web disappears, the opening valve increases in length, the serrulae of this valve reduce to a smaller area, and the respiratory pores of the tail end of the capsule to a longer one. This progressive series is accentuated by the recent discovery of an undetermined capsule from the North Atlantic (? *C. (Bathylophex) mirabilis*) received by the speaker from Professor Jungersen, of Copenhagen.

Some Interesting Reptiles: Mr. RAYMOND L. DIT-MARS.

The speaker exhibited a series of living lizards and serpents illustrating the salient features in the evolution and classification of these groups.

The serpents are undoubtedly derived from lizards. Some of the latter possess grooved teeth and a series may be arranged among them showing the progressive decline in morphological and functional importance of the limbs. This series begins with such a form as the dragon lizard (*Basiliscus*) with long hind limbs and which, in running, carries its body clear above ground. In other forms the limbs are not so well developed, so that the body rests entirely on the ground (*Heloderma*) or may even be dragged (*Cyclodes*). A connecting link between serpents and lizards was exhibited (*Ophisaurus*). This form looks exactly like a snake, but is a true lizard.

In the serpents there are no traces of external limbs, though with the boas and pythons internal ones are present. The jaw is greatly distensible, and true grooved or caniculated fangs are developed among many. A number of interesting points in the habits of the serpents were brought out.

Field Observations on the Fin Whales of the North Pacific: Mr. ROY C. ANDREWS.

Mr. Andrews gave an account, illustrated by lantern slides, of his experiences while at the whaling stations on the coast of Vancouver Island and southern Alaska. The paper was devoted to a discussion of the habits of some members of the family Balænopteridæ and of the modern methods employed in their capture. Many reproductions of photographs were shown on the screen illustrating the manner of spouting, diving and feeding of these whales. The speaker dwelt especially upon the peculiar manner in which the nasal region is protruded during respiration, and upon the attitudes assumed by the animals when diving. The method of feeding and the movements during play were also discussed.

L. HUSSAKOF,
Secretary

AMERICAN MUSEUM OF NATURAL HISTORY

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

At the 429th regular meeting of the society, February 16, 1909, Mr. Robert Grosvenor Valentine, the Assistant Commissioner of Indian Affairs, delivered an address on "The Unspoiled Indian," illustrating his remarks by the specific instance of the San Carlos Apache. The speaker said that the Indian had suffered less on account of that of which he had been despoiled than from the benefits which had been unwisely conferred upon him. He declared that he must be educated through his home, and therefore it is better to locate schools in Indian neighborhoods rather than remove the Indians from their homes and educate them apart as was the older government policy. In opening lands next to Indian reservations for settlement he believed it was important that the right kind of white men be induced to locate there. He favored opening such lands block by block to companies of settlers who had previously been neighbors rather than the present plan of throwing open all at once and bringing on a spectacular rush from all quarters.

The address provoked a lively discussion participated in by Dr. Merriam, Dr. McGee, Dr. Hough and the speaker, after which the president exhibited some blankets, belts and other articles made by the Apache and Navaho, and Dr. Merriam showed several pendants worked by California Indians out of feathers of the red flicker.

JOHN R. SWANTON,
Secretary